THE

ELECTRICAL REVIEW.

VOL. L. FEBRUARY 7, 1902. No. 1,263.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1902 Edition

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THE SUPPLY OF ELECTRICITY IN BULK.

THE subject of Mr. Hardman A. Earle's paper, read before the Manchester Section of the Institution of Electrical Engineers last week, deals with the most important subject of the development of the supply of electricity in this country. As Mr. Earle points out, large power stations have long been known in Canada, America, and on the Continent of Europe, but in this, as in some other matters electrical, the United Kingdom lags behind.

It was not until May, 1900, that Sir James Kitson's Committee pronounced the opinion—

> That the value of electrical energy as a means for the transmission and application of power has been amply demonstrated, and its importance to the industries of this country is admitted. The Committee accordingly advise that it is of public advantage to facilitate measures which may ensure a general supply of electrical power to all consumers who may seek to avail themselves of the economy and efficiency offered in the service of these sources of application of power.

This declaration, put forward with all the *eclât* of a new discovery, was in reality only the breaking down of the obstruction to private enterprise, which would have carried out the supply of electricity under great power schemes years before, but for the difficulty in obtaining the necessary sanction of the Legislature, and in overcoming the opposition of local authorities, backed up by professional witnesses, who now, to use Mr. Earle's phrase, will have to "eat their own words."

Upon one most important point Mr. Earle is silent, viz., the use of overhead transmission, which is the salient feature in the splendid examples of large power stations, of which he has mentioned the principal examples.

Mr. Earle considers that the English power schemes cannot be classed as speculative ventures, because of the success of the long-distance transmission of electrical energy in Canada and America. We fully believe that they will prove to be financially successful, as they are indeed absolutely necessary for obtaining a universally cheap supply, but it is of the utmost importance to deal practically with the question of overhead cables, and the means of obtaining legislative sanction to their use.

How, for example, are we to instal in this country systems working at, say, 40,000 volts with bare overhead conductors? That is a problem to which the attention of all interested in the question of long-distance transmission must be directed.

The Electrical Trades Section of the London Chamber of Commerce, in a memorandum to Mr. A. P. Trotter, electrical adviser to the Board of Trade, stated that "The Committee are strongly of opinion that permission to use overhead wires outside crowded city areas is *vital to the commercial success of power schemes over large districts*," and suggested that on this point the regulations should be brought into line with those current in other countries.

The reply of Mr. Trotter, which we publish to-day, is of extreme importance, as he points out that there are no regulations of his department which deal with extra high pressure, and that every case will be considered on its merits. No new regulations are therefore necessary, but the specifications of the works must be satisfactory to the B. of T. when submitted for approval.

The difference in cost between water-power and steam is not of so much consequence in a coal-producing country like our own, especially if cost of carriage, and the methods which exist of using the cheapest qualities by economical devices, are considered, but the least costly means of transmission is of much greater importance, and upon this point Mr. Earle's paper does not carry matters very far.

The highest voltage sanctioned by the Board of Trade has only reached 11,000, and this being for underground service involves a serious question of insulation. Mr. Earle calculates the cost of cables at £1,062 per mile, of which about one third is the estimate for digging trench, laying cast-iron trough and filling it up with bitumen, and handling cable. He does not say if his calculation includes re-instatement of the roads, and the exceptional cost in many places of dealing with level crossings of railways, bridges, &c., avoiding gas and water mains, sewers, drains, &c., and providing the necessary manholes for an underground service.

As the paper does not touch the question of overhead transmission, no calculation is made to show the difference in cost if the system adopted only involved wayleaves, posts, &c., and the saving in insulation and depreciation.

It would be interesting and valuable to have a comparative estimate of the difference in capital outlay between the two systems of overhead and underground transmission.

Mr. Earle believes that the power companies do not anticipate supplying the largest towns with energy. Why not? It is true that in most cases, owing to the opposition of the corporations of large towns, the latter have been omitted from the schemes, but there are no economical reasons why they should not be included and enjoy the same advantages as the small towns.

Mr. Earle has based a calculation of the cost and working of a large power scheme upon the probable results of the Yorkshire Power Company, and estimates a net result which would undoubtedly satisfy the most exacting shareholder. A 10·9 per cent. dividend on a share capital of £2,000,000, after providing 4½ per cent. on £666,666 Debentures, is comforting, but perhaps somewhat sanguine, as the whole of this profit is to arise from the sale of energy in bulk at an average price of 1·1d. per unit.

The Yorkshire Power Company has the advantage of a good area, three of the four power stations being situated on the coalfields surrounded with works and manufacturing industries, and with 12 miles only as the maximum distance for transmission. The intention is to put down 100,000 I.H.P., producing 50,000 KW. at the sub-stations. The sales are estimated at 123,700,000 units per annum, with a load factor of 25 per cent., derived from a sale of 15 per cent. for tramways and light railways, 60 per cent. for motors, and 25 per cent. for lighting.

Mr. Earle assumes that 20 per cent. can be sold without conversion, as a large load can be obtained within a three miles radius of the principal stations; this part of the business is, of course, exceptional, and helps the financial result without solving the problem of profit upon long-distance transmission.

The system adopted is three-phase, with 10,000 volts between any two of the three wires, each of these wires being at 5,775 volts difference of potential from the centre point.

This scheme has no doubt great possibilities, and is similar in many respects to that of the County of Durham Power Company, which also operates in a favourable area, and will secure a good load factor from tramways and motors especially, as well as from lighting; but in other cases larger proportions of demand will arise from the spread of light railways radiating from the large cities and towns, and from the longer hours of lighting.

Tramway Statistics.

THERE is an old adage to the effect that it is possible to prove anything by means of statistics; few men, however, will allow the truth of this provided that such figures are carefully obtained and intelligently used.

In tramway work, above all, statistics are of the utmost value; but we are compelled to admit that so far but little good has resulted from their use. This, however, is due, not to the figures themselves, but to the manner in which they are collected. Meaningless lists of car-miles, receipts, expenses, and similar figures, are put in a tabular form, and the readers are expected to cry "bene"; a far more appropriate cry would be "cui bono"; for certainly little, if any, benefit has accrued to anyone from such tables. The most essential figure is rarely given; indeed, few persons recognise its importance, while those who do, are in many cases most interested in suppressing it for the purpose of hiding their own delinquencies. The figure to which we refer is the number of car-hours. Now, in obtaining these it is important to allow for the time spent in getting the cars in and out of the depôt, or otherwise we shall find our figure showing the average speed per hour much too low, while the figure representing the average number of cars running would be too high. This last figure is necessary to show the "use factor" of the cars; many companies have cars representing thousands of pounds of capital lying idle in their depôts; all this would be saved if proper attention were given to the "use factor" of the cars.

Another feature which must of necessity impress the intelligent reader of tramway statistics, is the absolute indifference displayed so far as the track is concerned. If we were only given the number of car-miles per route mile, it would be a step in the right direction. The "use factor" of the track is practically the only figure suitable for comparing one line with another. It is in this comparison of different tramways that enthusiastic believers in statistics make their greatest mistake. Just as the mechanical world is worried by the man who believes in perpetual motion, so the tramway world loses all belief in statistics, owing to the crank who is always searching for some figure or combination of figures, which will entirely eliminate local circumstances. This is manifestly impossible; no fixed formula can possibly be applicable to such a fluctuating and indefinite abstraction, though approximations may be made by purely empirical methods.

The last point we would urge is this: Why does not some tramway man with a knowledge of mathematics pay some attention to data, and give us a really satisfactory series of figures to take the place of the present chaotic system? Few men seem to realise that if they have a certain number of figures given them for the purpose of finding another, it is absolutely essential that all the given figures should be used, if the result is to be worth anything. If serious attention were given to statistics based on proper mathematical principles, tramway companies would soon find their weak points, and start on a career of increased prosperity.

RECENT DEVELOPMENT OF THE ATOMIC THEORY AND ITS CONNECTION WITH LIGHT AND ELECTRICITY.

By C. C. GARRARD, Ph.D.

There can be no doubt that our ideas as to the constitution of matter, light and electricity are to-day more complicated than at any other time of recent years. The reason for this is not far to seek. Superseding the old confused and disconnected theories came during the last century the splendid generalisations of Dalton, Faraday and Maxwell. To these also must be added the development of thermo-dynamics and the work of Carnot, Clausius, Julias Robert Meyer, Helmholtz, Joule, Kelvin, Gibbs, Van't Hoff, &c., by which the oneness and indestructibility of energy were shown to be laws governing the whole domain of physical and chemical science. It is only natural, therefore, that the scientific world should have been to a certain extent blinded, and with the weight of purely empirical facts and disjointed theories lifted off its shoulders have been so elated at the apparent completeness and solidity of its work as for a time not to ask if its ideas of the universe were absolutely correct and strictly in accordance with observed fact. In quite recent years, however, this has changed, and to-day not only is the treasured inviolability of the atom of the chemist threatened with destruction, but the undulatory theory of light and electricity as the ultimate explanation of optical and electrical phenomena must also give place to a truer and wider conception. It was only to be expected that such a development should meet with serious opposition. More than one of our great chemists have declared that chemistry will stand or fall by the inviolability of the atom, and condemnations of the new physicoatomic theories, the ionic, electron, corpuscle theories, as reactionary, have not been wanting.* On a closer examination of the facts, however, it seems evident that a development, such as depicted above, must occur. Indeed, many things long since known have indicated the way. The atomic theory pure and simple, for example, leaves unexplained the periodicity of the properties of the chemical elements as functions of their atomic weights, which was shown to exist by Mendelejeff and Lothar Meyer, and other such cases might be instanced. It is with justice, too, that Prof. Nernst, in a recent address, claimed that modern physical investigation in electricity, dealing as it does principally with electrical oscillations, should not lead one to declare the nature of electricity to be a condition of oscillation, as little as one would be able to draw a final conclusion as to the nature of air by examining its oscillations in the study of acoustics.

Although in one sense the most recent conception of the nature of electricity is a return to the old fluid theory, yet it is with the most stringent adhesion to the results of the investigations of Maxwell and Hertz; and, indeed, it is improbable that we should have been led to these new ideas by any other way than that pointed out by these investigators. In the many experimental investigations which followed the discovery by H. Hertz of the existence of electric waves, which gave an experimental proof of the accuracy of Maxwell's theory, one of the chief difficulties has been the application of the theory to the optics of material bodies as apart from the light ether. H. A. Lorentz† showed that these difficulties could only be overcome by looking upon the individual molecules of a transparent body as pairs of electrically oppositely charged points, whose time of vibration then influences the light oscillations. Faraday's law of electrolysis now gives us information as to the nature of these charges, and forces us to the assumption of the existence of certain electrical elementary quantities. To these, what we may call electrical atoms, the name *Elektron* has been generally given. A proof of the correctness of this hypothesis was given by the discovery of P. Zeeman in 1896, of the so-called Zeeman effect. It was then shown that the spectrum lines of a luminous vapour were affected by magnetism. Instead of one line, the influence of the magnetic field caused two or more to appear. This discovery must be regarded as a proof of Lorentz's assumption, as the former can be directly theoretically deduced therefrom. By quantitatively measuring the change which occurred, it was shown that the mass associated with an electron (the mass of one electron) was about $\frac{1}{2000}$th that of an hydrogen atom, which is the smallest known chemical atom. It was further found that it was always the negative electron which was free to move, the positive electron being, on the contrary, always bound to the material. This is also found to be the case in all other electron phenomena.

The electron idea was also developed later in a somewhat other direction. As a result of the discovery of the X rays by Röntgen, the well-known cathode rays, the nature of which had long been a subject of conjecture, began to receive a large amount of attention from physicists. It is in this particular direction that such pioneer work has been done by J. J. Thomson and his co-workers. By means of accurate measurements, it has been shown that instead of being particles of the gas left in the tube, the cathode discharge consists of negatively-charged particles, moving with an enormous velocity (about $\frac{1}{3}$ to $\frac{1}{2}$ that of light), and whose size came out again to be about the $\frac{1}{2000}$th of that of the hydrogen atom.

The marvellous rays emitted by radium and other radio-active substances (Becquerel rays) have also been subjected to a like investigation. It was found that these bodies are continually emitting electrons, which travel from them at a velocity almost equal to that of light, and whose mass is again equal to the $\frac{1}{2000}$th of that of the hydrogen atom. A similar result was obtained with the emissions from incandescent bodies.

Very recent investigations on the electric conductivity of metals point also to the conclusion that their conductivity consists in the wandering of electrical atoms through the metal.

From this short summary it can be seen that the existence of these extraordinary small bodies, of which it seems very wonderful that we should be in a position to measure accurately their size and properties, is supported by a whole series of important discoveries, and it is probable that by means of further study of them, we may be able to arrive at results of vast magnitude. Seen in the light of this theory, many, until now quite inexplicable, phenomena, are capable of explanation, of which we can only mention the aurora borealis, and the origin and action of atmospheric electricity.

The electron theory is now capable of development from what may be called a chemical or electro-chemical standpoint. This has been done by Nernst, and for a fuller description of his way of looking at the matter, we would refer to a recent pamphlet of his: "Ueber die Bedeutung Elektrischer Methoden und Theorien für die Chemie."‡ A short *résumé* of Nernst's views and their development, as set forth in this pamphlet, may be given as follows: As chemistry consists in the study of the formation of molecules from atoms, and *vice versa*, electro-chemistry consists in the study of the production and action of ions. Owing to the peculiar property of water, it is in this medium that ions mostly are found, and it follows that water solutions are the most fruitful field of investigation of the electro-chemist.

For the investigation of ionised water solutions are applicable not only all purely chemical methods, but also those depending on the electrical charges borne by the ions. Arrhenius, for example, by the application of the Van't Hoff—Avogadro law, has determined the number of ions in solution, as compared to the number of neutral molecules. Hittorf has determined their constitution and identity with the chemical radicles; Kohlrausch has measured their mobility of migration, and Ostwald, by means of these methods, has given us a means of quantitatively measuring the strengths of acids. Nernst's method of measuring the E.M.F. of an electrode against a solution in which it dips, and therefrom obtaining the concentration of the ions of the metal of the electrode in the solution, has enabled us to prove the existence of amounts of substances in solution too small to be shown by any other method, that of spectrum analysis included.

(To be continued.)

* See *e.g.* Jaumann. "Leichtfassliche Vorlesungen."

† Compare here W. Kaufmann, *Physikalische Zeitschrift*, October 1st, 1901.

‡ Published by Herren Vandenhoeck I. Ruprecht, Göttingen.

D

THIRD-RAIL ELECTRIC TRACTION.

By E. GUARINI.

Installations for electric railway traction with a third-rail are far less numerous than those with the trolley system, although the number of the latter increases but slowly. It was in 1896 that the third-rail was adopted for feeding the motors of the cars, instead of the overhead wire, on the line between Braintree and Cohasset. This electric railway, finished in 1899, is about 17 km. in length, and is provided with rails that weigh 49·6 kg. per metre. The line is double, with a maximum gradient of 6·87 per cent; the minimum curve has a tangent of 10°.

The third-rail is at the same level as the others, between which it is placed, and it is supported on wood saturated with creosote. The section of the third-rail is **A**-shaped, and it has an area of 645 square millimetres.

In damp weather a loss of 2·5 amperes per kilometre has been observed.

The automobile closed cars weigh about 30 tons, and are propelled by four G.E. 55 motors, which are together capable of developing 700 H.P. The current is conveyed by means of skates, and the brakes act by compressed air. The normal speed is on an average 84 km. per hour. The consumption of energy on the cars is from 27 to 30 watt-hours per kilometre ton with trains that may amount to 118 tons in weight.

In 1898 two more electric railways were opened in America; one between Hartford and Bristol, about 29 km. in length, and one between Berlin and West Britain, about 5 km.

The first of these two railways is a single line, and the second a double line. The maximum gradient in either railway is 31 per cent. The minimum curve has a tangent of 10°.

The generating station is a single one, worked by steam. It is capable of developing 1,700 KW. It is about half-way along the line of 29 km., and near one end of the line of 5 km.; consequently in the line between Hartford and Bristol we get 14·5 km. of line on each side of the central station. The third rail is between the rails of the track; it weighs 49·6 kg. per metre, and has an **A**-shaped section of 645 sq. mm. The laying and the insulation are the same as in the Braintree—Cohasset line. The cars have two G.E. 55 motors of 175 H.P., but the mean power required by the car is 75 KW. The consumption of energy is from 34 to 51 watt-hours per km.-ton, with trains which weigh from 64 to 41 tons. The current is conveyed by the skate system.

On October 14th, after a long series of experiments, during which several regrettable mishaps occurred, the service of the Milan—Varese line commenced. It is worked by the Italian Mediterranean Railway Company, having been installed by the Thomson-Houston Company.

At present the ordinary service of steam trains has not been interrupted, but to these have been added 14 electric trains, *i.e.*, seven in each direction. The present service is a provisional one. There is only one stop at Gallarate. The charges have not been altered as yet.

The trains consist of carriages containing 24 seats in the first class and 49 in the third, besides the seats on the platform. Altogether in a train of two carriages there are 58 first-class seats and 110 third; there is no second-class.

The pressure of the current used (continuous current) is 600 volts. Its motive power is supplied at present by a steam central station, but it will soon be furnished by a hydraulic installation.

The Mediterranean Company and the Thomson-Houston Co. have taken every precaution to avoid accidents. For instance, they have had recourse to electric brakes. Moreover, for the level crossings there are protective constructions of wood; and, lastly, notices are posted about in several places warning the public that it is dangerous to touch the third rail. For the normal service the charges will be very much reduced. There will be a very large number of both express and ordinary passenger trains; some of these will also take luggage.

The normal service has been delayed owing to its novel character, which requires a special organisation. It has therefore been necessary to commence with a temporary service, which not only constitutes a very great improvement for the public, but also has the advantage of preparing and facilitating the change to a complete electric service.

It is well known that Italy depends on foreign countries for her coal. All the experiments that are being made in Italy in electric traction will therefore be followed with great interest, since by utilising the hydraulic resources in which the country is very rich, she will require far less coal and therefore be far less dependent on other countries.

LEGAL.

Ferranti *v.* The British Thomson-Houston Company, Limited.

In the Chancery Division of the High Court on January 29th, Mr. Justice Swinfen Eady gave judgment in the above action.

His Lordship said: This action was commenced in December, 1900, and was brought to obtain an injunction to restrain an infringement of letters patent, No. 701, of 1887, and for damages. The term of the patent expired shortly after the issue of the writ, and the action was therefore treated as one for damages only. The defence is a denial of the infringement, and a plea of the invalidity of the letters patent. The patent relates to improvements in electrical meters. Previous to 1887 the plaintiff had invented an electrical meter in which the current to be measured was made to pass through a bath of mercury in a magnetic field, so disposed that the mercury was put into a continuous rotatory movement by the passing of the current, the movement of the mercury being recorded by means of a float or disc with recording mechanism. The plaintiff stated that such a meter patented by him in 1883 was used commercially to the extent of a few hundreds, but that the business of a central station supply in those early days of electric lighting being exceedingly limited, very few meters were required. That meter was designed for use with the continuous current, and with a solid magnet made of cast-iron; the residual magnetism of the cast-iron served to assist in causing rotation of the mercury, and was sufficient to enable the meter to start, even with only a small number of lamps in use. In order to adapt that meter for use with an alternating current, it was necessary to employ pole-pieces which did not retain residual magnetism, and laminated iron was substituted for solid cast-iron magnets. Then, in order to effect the object previously attained by the residual magnetism, and so enable the meter to start and register correctly with a low load, some contrivance was necessary. The plaintiff, in 1887, determined to achieve this result by employing an additional coil of an insulated conductor, which would act as an electro-magnet, and thus compensate for the loss of residual magnetism arising from the abandonment of solid cast-iron magnets. This invention formed the subject of the letters patent of 1887, upon which this action was brought. The question at once arises—what is the true construction of the plaintiff's specification, for the defendants contend that on one construction of it they have not infringed, and on another construction of it that the patent is invalid? The argument as to the construction of the specification has been principally directed to two points—first, whether the invention is confined to electro-magnets in which the current passing through the additional coil does not pass through the mercury bath or other armature of the meter; and (2) whether the plaintiff has limited his invention to current meters properly so called, as distinguished from energy meters. The plaintiff states in his specification that in meters which are to be, or which may be, used for recording alternating currents, he uses pole-pieces which do not retain residual magnetism, and to effect the object previously attained by the residual magnetism, he uses an additional coil or coils around the pole-pieces, and then proceeds as follows:—"The current passed through these additional coils forms no part of the circuit, the current through which is to be measured, but is a branch circuit direct from the main conductor to the return conductor." The plaintiff contended that the true meaning of these words is that the current so described is a shunt from the main to the return conductor direct, in the sense of not passing through the lamp circuit, and so not measured or paid for by the consumer. The defendants contend that the same words mean a shunt current from the main to the return conductor direct, in the sense of not passing through the mercury bath of the meter or its equivalent. It is necessary to examine these two contentions carefully, as much turns upon them. The plaintiff has annexed to his specification certain drawings showing examples of two meters, and referring to the first example he states:—"The ends of the additional coil are as before stated, so coupled to the mains that the current passes through it continuously, without passing through the mercury bath." The only passage in the previous portion of the specification to which the words, "as before stated," can have reference, is in line 24, on page 2. Again on page 3 there are similar words referring to the second example of a meter given in the drawings, and there again the branch circuit is described as conducted from the mains without passing through the mercury bath of the meter. This again shows what is meant on page 2, line 24, by a branch circuit direct from the main to the return conductor. The plaintiff, however, contended that the words to which I have referred on page 3 are merely words of description with reference to the two examples given, and are not words of limitation. In a sense this is true. These words have reference to the two examples given, but the importance of them in this connection is the light which they throw on the meaning of the words on page 2, lines 22 to 25. It is maintained by the defendants that the construction of this portion of the specification which they contend for is of the very essence of the plaintiff's invention, that is to say, that the current passing through the additional coil is not to pass through the mercury armature. One reason may have been this. The object of the plaintiff's invention was to render his meter more sensitive to small loads, but at the same time to avoid the risk of the meter commencing to register when no lamp current was in use. In other words, it was to obtain an additional torque or tendency to turn, and at the same time to avoid the possibility of the mercury revolving, the meter running, and the index registering before it was intended to turn at all. Mr. Dugald Clerk, a witness called for the plaintiff, stated this very clearly in his evidence; and it appears from the evidence called on behalf of the plaintiff that there was certainly one very good reason why the current employed to obtain an electro-magnet should pass direct from the main to the return conductor without going through the mercury armature. So long as there was not any current passing through the mercury there was not any risk of the meter running. As Mr. Clerk said, the motor was not completed; when, however, lamps were turned on, the lamp current would then flow through the mercury, and the current in the shunt coil being constant the meter would immediately begin to register, however few the lamps lighted. But if the shunt current passing through the additional coil had also passed through the mercury bath, there would have been a risk of shunt running, of the meter commencing to register by the force of the shunt current only, and without any lamp current also passing. The essence of the plaintiff's invention as

specified and claimed (see Clause 1 of the claim) is an improvement in electric meters in which the movement is obtained from the current to be measured, and he ensures this result and guards against any movement resulting from the current in the added coil by providing that such current shall go direct from the main to the return conductor, and in my judgment the proper construction of these improvements is that such current shall not pass through the mercury bath or other armature of the meter. While improving electric meters by rendering them more sensitive to light loads, the plaintiff has taken care not to fall into the error to so construct them as to involve risk of their registering when no lamp current is passing. The plaintiff's counsel strenuously insisted upon the importance of the words on p. 2 line 25: "The same improvement is applicable to all motor meters," but if the improvement is specified and claimed in the manner before mentioned, a statement that "the same improvement" is applicable to all motor meters cannot enlarge the ambit of the invention. The next question is whether the plaintiff has limited his invention to current meters properly so called as distinguished from energy meters. The plaintiff's meter is one which measures current or quantity, giving the result in amperes, and if the potential remains constant, the number of watts may be readily calculated from the result so obtained; but the plaintiff's meter does not measure variations in the potential. Mr. Dugald Clerk explained the difference. (His Lordship then referred to Mr. Dugald Clerk's evidence on the subject.) Now, as to the defendants' meter, Mr. Dugald Clerk explained its action by referring to Diagram C of Exhibit D.C. 6, which was defendants' meter before the addition of the new coil. (His Lordship again referred to the shorthand notes of Mr. Dugald Clerk's evidence.) The result is that the defendants' is an energy or watt meter, while the plaintiff's is a current meter. His Lordship then referred to the evidence given by the plaintiff on a former occasion, in which he said that, speaking as an electrician, an energy meter was entirely distinct from a current meter, it having a different function to perform, and having to take account of the pressure and the quantity, namely, the energy, instead of taking account only of the quantity of current passing. His Lordship, continuing, said that Mr. Ferranti, in his previous examination, was asked: "Would the same electrical principles or mechanism be involved in an energy meter as in a current meter? (*a*) Some of the same things are involved, but the essential difference is that the two parts of the motor, namely, the armature and the field, must be connected, the one in circuit with the lamps to be measured, and the other across the circuit, so as to receive the voltage of the circuit, in order to form an energy meter; whereas with the current meter you only deal with the main current of the circuit flowing from the lamps. The difference is most distinct. The end to be accomplished is also quite distinct." In my opinion, said his Lordship, current to be measured in the plaintiff's specification means the lamp current. In other words, it extends only to a current meter, and does not include the case of an energy meter which measures and records the product of two variants, the quantity and the potential, without measuring separately either variant. This being, in my opinion, the true construction of the plaintiff's specification, I pass to consider what the defendants have done. The original Thomson-Houston meter, before the introduction of the additional coil, which is the infringement now complained of, is shown in fig. C, and the exhibit D.C. 6. The continuous movement of the meter which is connected with the record index, is obtained by the interaction of the force derived from the shunt current passing through the armature and that derived from the lamp current passing through the series coils—when no lamp current is passing through the series coils (as is the case when no lamps are running), there is no risk of movement in the meter, as the shunt current alone cannot set up any movement of the meter. So far no complaint is made by the plaintiff of the use by the defendants of this meter, but the defendants have introduced into it the additional coil, and this gives rise to the present claim. The meter is arranged as shown in fig. D in D.C. 6. The defendants, in order to increase their magnetic field, introduced a coil into the shunt passing through the armature; the effect of this is to have a constant standing field interacting with the rotatory field, and so to give a torque to the meter, even when no lamp current is passing. The defendants lead the current through the armature, which, upon my construction of the plaintiff's specification, a person is told by the plaintiff not to do. The meter is thus rendered more sensitive to a feeble lamp current, and registers when only one lamp is lighted. In the defendants' meter, however, the torque is always constant, whether lamp current is passing or not, while in the plaintiff's meter the initial torque when no lamp current is passing is zero, and, for a time, the torque increases proportionally to the number of lamps. The question is: Does this application to a Thomson-Houston meter of an additional shunt coil constitute an infringement of the plaintiff's patent? In my judgment it does not. The defendants have made the use of an old contrivance—an additional coil—and have applied it in a manner which is not within the plaintiff's specification, and in which the plaintiff told persons not to do it. The defendants have, therefore, not infringed. Moreover, they have applied it to an energy meter, and not to a current meter. The action, therefore, fails, and must be dismissed, with costs.

Judgment accordingly.

PATENT EXPLOITATION COMPANY, LIMITED, *v.* SIEMENS BROS. AND CO., LIMITED.

ON this case being resumed on 23rd ult., Mr. MOULTON continued his statement for the defence. He said he might sum up the plaintiffs' patent by saying that it was not a claim for effecting the chemical construction of a battery.

Mr. Justice BUCKLEY asked whether it was common knowledge that it was an advantage to keep the depolariser away from the anode.

Mr. MOULTON said that it was.

Mr. ASTBURY: At any rate, it was not done in any of the prior specifications.

Mr. MOULTON, continuing, said that what was really claimed by the plaintiffs' patent was a double paste battery. Single paste batteries were well known, and there was no invention in making a double paste battery. The fact that the thing not having actually *de facto* been made was not sufficient to constitute invention. There was no invention in the plaintiffs' patent at all. The patentee had simply availed himself of a known option. The double paste battery was old in the very form in which the plaintiffs preferred to use it. A double paste Leclanché was well known.

Mr. JAMES SWINBURNE was the first witness called for the defence. Examined by Mr. MOULTON, he said he studied electricity, and had a large experience of electric batteries. Various methods of making the electrolyte into a pasty condition were known before the date of the patent in question. Plaster of paris was well known for Daniell cells. The pounding of the carbon and manganese for these purposes was well known in 1890. With regard to "Bender," the witness said that, speaking as an electrician, he understood that specification to mean that the excitant fluid must permeate the whole. Everybody knew that at that date that it was to the advantage of the cell to have as much liquid as it would hold. Chloride of calcium and chloride of zinc were about the same value as a hygroscopic medium. Examined as to Castle Smith, the witness stated that, except for the position of the two layers, that specification differed neither from Bender's nor the plaintiffs'. Castle Smith, instead of a paste, had got a jelly. In the Gassner (Dymond) patent, plaster of paris, chloride of zinc, and sal ammoniac were used. Newton suggested silica and some fibrous substance. That was silica gelatinised. With regard to the plaintiffs' patent, the witness said that he had read the specification and the claim. In the method of construction—the actual process, apart from the question of materials—he could find no novelty at all in the plaintiffs' claim. With regard to the materials, plaster of paris, sal ammoniac, and chloride of zinc were well known, and there was nothing novel there. So far as the electrical essentials were concerned, it did not differ in any way from Leclanché. He should describe the plaintiffs' patent as a paste Leclanché. In 1890, in his opinion, it did not require any invention to make a paste Leclanché.

Do you see, reading the claim as an electrician, anything general or specific otherwise than what was generally known?—No.

Cross-examined by Mr. CRIPPS: As regarded the polariser—the peroxide of manganese—the WITNESS said it was not always known that it was beneficial to use it in the powdered form. The advantage of using it in the powdered form was new to him until he came into this case. He had not looked up the literature on the subject to see what occurred to other people on the point. At some date prior to 1890, it was the idea of electricians to avoid powdering the peroxide of manganese. He did not know whether any cell was ever made under Bender's specification. The Witness stated with regard to Thiebaut and Bender, that he found in those what was equivalent to two layers of the semi-solid or paste-like character used in the sense of the plaintiffs' specification. "Paste" was not a word he should apply to either, but the only possible difference as to that was in the meaning of the word "pulverised."

Mr. HORATIO BALLANTYNE, a Fellow of the Chemical Society, examined by Mr. WALTER, gave details of experiments he had made with various batteries described in the specifications prior to the date of the plaintiffs' patent. He found that these batteries were all workable.

This concluded the evidence for the defence.

Mr. WALTER was summing up the case for the defendants when the Court rose, and the further hearing was adjourned.

On 24th ult., when the hearing of this case was resumed, Mr. A. J. WALTER, for the defendants, said that when the Court rose on Thursday, he was dealing with the specification, and his contention was that the claim in the specification, taking it together with the specification, did in the broadest manner, claim any galvanic battery so constructed that between any two electrodes, there were two layers with any excitant, one having depolarising agents mixed therewith. There had been a struggle on the part of the plaintiffs to somewhat narrow the construction upon the specification. It had been difficult to ascertain exactly what construction the plaintiffs sought to put upon it, and what were the limitations the plaintiffs sought to place on the broadness of the claim. But if there was one thing that was laid down in patent cases more than any other, it was that you had to let the public know, reading the specification, what were the special features, if any, claimed in the specification. He asked: Had the patentee condescended, with the exception of the two layers, as between the two electrodes, upon anything else which he told the public was essential? He submitted to his Lordship that he had not done so. His Lordship would remember his cross-examination of Dr. Attfield on the point as to what was common knowledge, and Dr. Attfield admitted, he thought, throughout, that what the patentee had disclosed here was common knowledge. (The learned counsel then referred to the shorthand notes of the evidence of Dr. Attfield on the point.)

His LORDSHIP pointed out that Thiebaut used no bag, and put his powders in dry and wetted them afterwards, and, further, used pounded, and not pulverised, material. Those were the points of difference.

Mr. WALTER said that those were the two points of difference.

His LORDSHIP: Then you must add this, must you not? In point of fact, it is not disputed. I think, upon this evidence, that

the plaintiff produced an article which achieved a commercial success not achieved before.

Mr. Walter: I do not know that it goes as high as that.

His Lordship: Let us suppose that is so for the moment—that was due to something?

Mr. Walter: That was due to something.

His Lordship: The question is, was it due to something which he claims?

Mr. Walter: I say it was not, my lord.

His Lordship: You say in the first place Thiebaut might do?

Mr. Walter: Absolutely.

His Lordship: It never did so, seemingly.

Mr. Walter: Your Lordship has experience in these cases, and your Lordship knows that many and many a patentee has a splendid invention, but he is not a commercial man, and he has no opportunity of bringing it before the public.

His Lordship: Is not the result of Mr. Swinburne's evidence this—that the merit of the plaintiffs' article really consists in pulverisation, as distinguished from pounding. I do not think that he denies it is a better thing—it is a better thing. I think that the case resolves itself into this:—Has this patentee indicated to the public, as essential to success, that they shall have, in the first place, a depolarising material capable of being pulverised; and, secondly, that it shall be pulverised in the sense of being reduced to a very fine powder as distinguished from being pounded?

Mr. Walter: That is so, my lord.

His Lordship: Then there is something—that he has indicated that. But the next question is, has he claimed it?

Mr. Walton: My position with regard to that is, first of all, he has not indicated it at all. He says you never need manganese dioxide or carbon at all. Reading that specification fairly as between the patentee and the public, is there one hint in that specification that pulverised manganese, dioxide, or any substance which can be pulverised, is of the essence of this invention? Continuing, the learned counsel contended that Thiebaut had every essential of the plaintiffs' specification. The bag had gone, and as his Lordship had pointed out, there was a difference between pounded and pulverised and the wetting. That was to say, the patentee said "put your whiskey in first and put your water in afterwards." The other man said "put your water in first and your whiskey in afterwards." That was absolutely what the difference was. Dr. Attfield had said that the action of water upon plaster of Paris was well known. A man came there and said he differentiated the invention from what had gone before. The one man put in the water after the powder, and the other man put in the powder after the water. That was the whole difference; polarising was a question of degree, which was perfectly understandable by a scientific man. It was perfectly well known what the action of a depolariser was in these batteries. The patentee did not tell you anything about your excitant or depolariser. It was common knowledge in the year 1891, and admittedly so. Therefore he was entitled to take manganese, dioxide and carbon as his depolariser and sal ammoniac as his excitant, and then where was the difference and what was the difference? Bender did the same thing exactly. Bender has described the cell for the purpose of preventing it drying up. Webb and Jensen pointed out that you could have your paste hard or soft. In conclusion, the learned counsel submitted that, first of all, the specification claimed, broadly, any galvanic battery with two pasty layers—semi-solid or plastic layers—with any electrodes, with any excitants, and with any materials, but for depolarising, so long as the depolariser did not come into contact with the zinc. In every battery that was known at the time the excitant was always in contact all the way through between the carbon and the zinc, and in addition the use of deliquescent materials was perfectly well known; and, of course, coming to the question of the actual anticipations, he said that the two pastes were absolutely disclosed. If there was anything in the special feature in the method of construction as disclosed in the plaintiffs' specification, the defendants did not take it, but he (counsel) said that on the true construction of the specification the defendants' patent properly constructed had the broad claim, and for those reasons he asked his Lordship to find for the defendants.

Mr. Astbury having replied on the whole case.

On 31st ult. Mr. Justice Buckley, in the course of his judgment, said that the issue was novelty, and not either utility or infringement. The plaintiffs' battery for some reason attained a commercial success never attained before, and, although it did not necessarily follow from that fact that the invention had utility, still it went a long way to show it. Dr. Attfield had analysed the defendants' battery, and said that it was made in accordance with the plaintiffs' prescription, and upon this he had not been cross-examined. There was not sufficient difference to relieve the defendants from infringement if the plaintiffs' patent was valid. The real issue was the novelty of the invention "claimed." His Lordship used the word "claimed" because, even if the plaintiffs' patentee invented something, if he had not included it in his claim, he had but made a present of it to the world. In trying this issue the case turned upon the question whether, first, by the word "pulverised," the plaintiffs had indicated and insisted upon the use of an ingredient which could be reduced to a powder, and had further indicated something more than would be indicated by the word "pounded" or "crushed," and, if that was answered in the affirmative, then, secondly, whether he had claimed such pulverisation as an invention for which he was to obtain protection by his patent. At the date of the patent, 1890, the general principles of the construction and arrangement of galvanic batteries were well known. A common form of such batteries consisted in having a zinc cup, an excitant to attack the zinc and produce energy, a carbon rod as the other electrode, and a depolariser to prevent the falling off in power of the cell which would otherwise occur. In 1890 it was well known that for success it was desirable to interpose between the zinc and the carbon two layers of substance through both of which should extend the exciting mixture, but through only one of which—that next the carbon—should extend the depolarising agent, and that it was necessary to ensure moisture, so that there might be a wet path for the current to travel, and that for this purpose a hygroscopic substance was desirable, and that the layers interposed between the zinc and the carbon might be either liquid, or pasty, or porous. It was known that the space between the zinc and the carbon might be the subject of occupation by either a fluid or fluids, or material substances and a fluid. Where you desired to have (as was advantageous) a battery the contents of which would not spill, it was desirable to have joint occupation by material substances and a fluid. After going through the alleged anticipations, his Lordship decided that there was no novelty in the invention claimed, and that the claim was too wide, and he therefore held the plaintiffs' patent to be invalid, and dismissed their action, with costs.

Maxwell *v.* British Thomson-Houston Company, Limited, Blackwell & Co. Third Parties.

The hearing of this case was concluded in the Court of Appeal composed of the Master of the Rolls and Lords Justices Romer and Mathew, on Friday last, on the appeal of the defendants from the judgment of Mr. Justice Kennedy after trial of the action with a special jury at Leeds. The action was brought by the plaintiff, Miss Maxwell, against the defendants, the British Thomson-Houston Company, Limited, to recover damages for personal injuries caused by the alleged negligence of the defendants' servants. The defendants denied liability, and contended that if they were liable they had a right of indemnity against Blackwell & Co., and accordingly brought them in as third parties to the action. The question as to the liability of the defendants was alone tried at Leeds, their right of indemnity against the third parties standing over. It appeared that the Corporation of Leeds owned certain horse tramways and obtained statutory powers to work the tramways by electrical power, and for that purpose entered into a contract with defendants, who undertook to convert the tramway system and equip it with electrical overhead wires. The defendants entered into a sub-contract with Blackwell & Co., by which the latter were to erect the iron standards with arms along the streets to carry the overhead wires, and to fix the wires. To do this work, Blackwell & Co. used a tall derrick or trolley on which was a platform on the top, which projected beyond the side of the derrick to enable the workmen to reach the arms of the standards, and so fix the wires. Round the edge of the platform were iron rails to protect the workmen while at work on the platform. The plaintiff, who was riding on a car in the daytime, was struck on the head by these iron rails as the car was passing the derrick and seriously injured; the accident being caused by some workmen in Blackwell & Co.'s employment leaving the derrick too near the tram lines after they had finished work, and leaving the iron rails projecting from it. The Jury found that the persons in charge of the derrick were responsible for the accident by reason of negligence in not taking reasonable care to remove the derrick far enough away from the tram lines. The amount of the damages was agreed upon. Mr. Justice Kennedy held that the defendants were liable, and gave judgment for the plaintiff. Hence the present appeal of the defendants, who contended that they were not liable for the negligence of the sub-contractors. They also contended that the Corporation of Leeds were liable, and that they, being merely intermediaries, were not liable.

At the conclusion of the arguments of counsel, their Lordships held that the defendants by delegating the portion of the work in question to Blackwell & Co., did not relieve themselves from the duty of taking special precautions for the safety of the public, and that they could not escape liability by delegating the work to a sub-contractor. They therefore affirmed the decision of Mr. Justice Kennedy, and dismissed the appeal with costs.

Mr. Macaskie, K.C., and Mr. Horace Marshall appeared for the appellants (defendants); and Mr. Tindal Atkinson, K.C., and Mr. Longstaffe for the respondent (plaintiff).

Gibbs *v.* The Chloride Electrical Storage Syndicate, Limited.

This case came before the Court of Appeal, composed of the Master of the Rolls and Lords Justices Romer and Mathew, on Tuesday, on the appeal of the defendants from the judgment of Mr. Justice Bigham, dated April 2nd, 1901, sitting without a jury in the King's Bench Division. In this case the plaintiffs' claim was for £487, the balance of the price of goods sold and delivered to the defendants. The defence was that, owing to some of the sulphuric acid supplied by the plaintiffs being of greater strength than that contracted for, and to the fact that certain carboys contained hydrochloric acid, damage was done to certain batteries, and on this account the defendants counterclaimed for £579 9s. 5d. The only point in dispute was the defendants' counterclaim.

The defendants' case was that they had, since the year 1896, purchased sulphuric acid from the plaintiffs, and contracted for acid which was not to be higher or lower than 1 250 specific gravity, and which was to be pure brimstone acid. The defendants alleged that the plaintiffs knew that the acid was used for storage batteries, and

that it must be of the exact strength. In December, 1899, defendants had a large order for storage batteries for Prince Hatzfeldt, and ordered from the plaintiffs 86 carboys of acid to be delivered to the firm of contractors who were putting in the installation. The 86 carboys were delivered, and it was said they contained 0·2 per cent. of hydrochloric acid, which had got there by common salt having been put in the acid. The contents of the carboys were poured into the storage cells, with the result that they were destroyed. The defendants estimated that the damage resulting there was £723 5s. 4d. For another installation the defendants were putting in storage batteries, and directed the plaintiffs to deliver in November, 1899, 36 carboys of acid of the specific gravity of 1·215. The defendants' case was that plaintiffs supplied acid of the specific gravity of 1·750, and on two of the carboys being poured into the cells, the cells were destroyed. The damage on this head was put at £24. Another head of claim by the defendants was for 30 carboys, ordered from plaintiffs in October, 1899, where the acid delivered was of the specific gravity of 1·740 instead of 1·250.

The case for the plaintiffs on the counterclaim was with regard to the item of £24 that the mistake arose through the railway company mixing two consignments. With regard to the larger claim, they denied that there was any hydrochloric acid contained in the acid supplied at all, and further, that if there was, it could not do the slightest harm. Mr. Justice Bigham, after hearing evidence, was of opinion that the damage done to the batteries was not due to the acid supplied by the plaintiffs, but, he thought, on the other hand, that the plaintiffs had not delivered the acid which they undertook to deliver. He accordingly gave judgment for the plaintiffs on the claim, and for the plaintiffs on the counterclaim, but without costs. Hence the present appeal of the defendants.

Mr. Thomas Terrell, K.C., for the appellants, said that the learned Judge must have been misled by one of the plaintiffs' witnesses, and did not appreciate what the evidence amounted to. If he had he would have found that the damage to the batteries was caused by the acid supplied by the plaintiffs.

The hearing was adjourned.

Bright's Trustee *v.* Marino & Bright's Light and Power Company.

Mr. Eve, K.C., last Friday, applied to Mr. Justice Swinfen Eady for an injunction to restrain the defendant, Mr. Marino, from voting at any meeting of Bright's Light and Power Company in respect of certain shares standing in his name on the register of the defendant company. He explained that last week the company undertook not to deal with the shares, but the defendants declined to give an undertaking as to voting, on the ground that evidence would be forthcoming by to-day to support their case on that point. No evidence had been filed, and he therefore asked the injunction.

His Lordship granted an injunction in terms of the notice of motion.

British Electrical Manufacturing Company.

A motion in a debenture holder's action against this company was brought before Mr. Justice Swinfen Eady on Friday last in the Chancery Division. Mr. Houston, for the plaintiff, said his client was the holder of the debentures of the company amounting to £2,000, and the company was being wound up voluntarily.

Mr. Winney said that the plaintiff had not proved that his debentures were registered.

Satisfactory proof of registration was immediately forthcoming, and Mr. Houston, in asking that the liquidator be appointed receiver and manager, said that a manager was necessary as contracts were in progress, and it would be a serious thing if the business were stopped.

His Lordship made the order asked for.

PARLIAMENTARY.

On Monday the following Bills came before the Examiners of the House of Commons for proof of compliance with Standing Orders:—

Mexborough and Swinton Tramways.—A Bill to incorporate the Mexborough and Swinton Tramways Company, and to empower the company to make tramways and tramroads, &c. Power is asked to construct certain tramways, and to enter into an agreement with the Rawmarsh Urban District Council to construct the tramways which the Urban District Council were authorised to construct under their Act of 1900, and to enter into an agreement with the Corporation of Rotherham for the working of the Rotherham tramways. The works intended to be carried out under the Bill are four lengths of tramway, one of which is over 2 miles in length, and one about 1½ miles long. Power is also asked to take and use a piece of land 9 acres odd in extent, situated in the Urban District of Swinton, for the erection of a generating station. The authorised capital is £150,000, and the company may borrow on mortgage sums not exceeding £25,000 in respect of each £75,000 of capital. The first directors will be Messrs. W. Binns, F. Hawe, and E. A. Paris. In the event of the company undertaking the obligations imposed upon the Corporation of the Rotherham and the Rawmarsh Councils by the Tramways Acts in respect of certain bridges, the company may, during the continuance of any agreement, exercise the powers conferred upon the Corporation of Rotherham and the Rawmarsh Council for the construction and reconstruction of the said bridges. With respect to the purchase of the undertaking by local authorities, the Bill asks that the period of 42 years should be substituted for the 21 years mentioned in the Tramways Act of 1870. The examination of the Bill was postponed until February 10th.

Saddleworth, Springhead and Lees Tramways.—Under this Bill the Saddleworth, Springhead and Lees Tramway Company is sought to be incorporated for the purpose of constructing and maintaining tramways in Saddleworth, Springhead and Lees. The length of the tramway lines proposed to be made is about 14½ miles, and it is also proposed to make a new street and a new bridge across the River Tare, at a point about 4 chains west of the Delph Bridge. The gauge of the tramways is to be 4 ft. 8½ in. The capital of the company is to be £150,000, with borrowing powers up to £50,000. Owing to the late deposit of the money, Standing Orders were found not to have been complied with, and the Bill will accordingly have to go before the Standing Orders Committee, who will decide whether it shall be allowed to proceed.

Scarborough Tramways.—Particulars of this Bill were given in the Electrical Review of January 31st. Briefly, the powers sought are the incorporation of a company to lay down a tramway service in the borough.—The examination was further postponed till February 10th.

City and Brixton Railway.—Standing Orders were found to have been complied with in respect of this Bill, which authorises an extension of time in regard to the purchase of land and the entering into agreements with the City and South London Railway Company for the working of the railway.

City and Brixton Railway (Abandonment).—Under this Bill power was sought to abandon and relinquish the construction of the underground railway and works respectively authorised by the Acts of 1898 and 1899.—There was no attendance, and the Bill was marked "dead."

Manchester District Telephone Board.—This Bill is described as one for constituting and incorporating a board to consist of representatives of the Corporations of Manchester, Salford, Stockport and Eccles, and the Urban District of Stretford, and authorising the board to provide a system of public telephonic communication in and in the neighbourhood of the City of Manchester. According to the Bill it is estimated that the board could provide machinery, conductors, and apparatus for carrying on the business proposed to be undertaken for £150,000. This plant would be sufficient to place Manchester, Salford, Eccles, Stockport, Ashton-under-Lyne, Alderley Edge, Altrincham, Audenshaw, Ashton-on-Mersey, Bowdon, Cheadle, Gatley, Denton, Droylsden, Failsworth, Gorton, Heaton Norris, Irlam, Knutsford, Levenshulme, Moss Side, Prestwich, Swinton, Pendlebury, Sale, Stretford, Wimston, Whitefield, Worsley, Withington, Wilmslow, Burton-upon-Irwell, Limehurst, and the Macclesfield and Stockport rural districts in telephonic communication with each other. It is proposed that the board managing the telephones shall consist of ten representatives of the Manchester Corporation, five from the Salford Council, two from Stockport, and one each from Eccles and Stretford. The members of the board must be members of the Councils of the districts they represent, and the board is to operate so long as it has the Postmaster-General's license to do so. It is provided that the profits or losses shall be divided proportionately to representation among the Corporations constituting the board. Standing Orders were found to have been complied with.

Bexhill and Rotherfield Railway.—This is a Bill for the abandonment of the Bexhill and Rotherfield Railway. The company was empowered in 1891 to make the railway, but none of the powers had been exercised. Standing Orders were found to have been complied with.

Scotch Private Bills.

The following Bills, amongst others, came before the Examiners of the House of Commons on Monday for proof of compliance with Standing Orders. Under the Private Legislation Procedure (Scotland) Act, 1899, local inquiries will be held with regard to the measures, instead of the opposition being heard before a Select Committee, as is the case with English Bills:—

Rothesay Tramways (Extension).—This Bill is to authorise the Rothesay Tramways Company, Limited, to construct additional tramways. In 1880 the company was authorised to construct and maintain tramways partly in the Royal Burgh and parish of Rothesay, and partly in the parish of North Bute, and the company now proposes to lay down additional tramways, and work the same by electric traction. Five lengths of tramways are sought to be constructed, one of which is 2 miles 2 furlongs long, situated in North Bute, and another 1 mile odd in length situated in Rothesay. A number of street widenings are proposed, and land is scheduled for a generating station. Clause 26 empowers the company to apply for, or to take, transfers of Electric Lighting Orders. It was found that Standing Orders had not been complied with, and the Bill will have to go before the Standing Orders Committee.

Aberdeen Suburban Tramways.—Under this Bill it is sought to incorporate and confer powers on the Aberdeen Suburban Tramway Company, and the tramways proposed are as follows:—No. 1, 1 mile 4 furlongs 6·70 chains; No. 2, 4 furlongs 2·30 chains; No. 3, 5 miles 5 furlongs 8 chains; No. 4, 4·50 chains. The capital will be £72,000. It is provided in the Bill that No. 2 tramway shall not be constructed within 12 months of the passing of the order, except with the written consent of the Aberdeen Corporation, and the Corporation may, if desirous, within the 12 months require the

company to transfer the powers vested in them by the Act with respect to this particular line on the Corporation paying a proportion of the expenses of obtaining the Act. It further provides that the Corporation may, on giving six months' notice, purchase the tramway No. 2 at any time after construction. Power is given for the company to enter into agreements with the Corporation for the combined working of the company's and the Corporation's tramways. The examination of the Bill was postponed until February 10th.

Glasgow Corporation.—Various powers are sought under the Glasgow Corporation Bill, and amongst them are powers to supply electricity where the consumer has a separate supply, and to supply electric motor fittings, &c., and to exempt the same from distress. Standing Orders were found to have been complied with.

Greenock and Port Glasgow Tramways.—The Greenock and Port Glasgow Tramways Company seek further powers with respect to their tramway undertaking in the Borough of Port Glasgow. A new length of tramway will be constructed, and power to work motor cars and omnibuses in connection with their undertaking is asked. Authority is also asked to raise £65,000 additional capital. The necessary proofs of compliance with Standing Orders were forthcoming.

WATER-TUBE BOILERS.

A RECENT question in the House by Mr. W. Allan, of Sunderland, for whose persistent annoyance of the Admiralty we think he has deserved the thanks of the country, brought out a statement from Mr. Foster that the report on the *Minerva* and *Hyacinth* trials will soon be issued. We hope that "soon" may be interpreted literally, for we believe that if the report speaks the truth, the whole truth and nothing but the truth, it should render impossible any return to Belleville boilers or any similar type. Our esteemed contemporary the *Engineer* uses the occasion once again to insist that water-tube boilers of the large tube variety cannot safely possess tubes whose length exceeds 25 diameters, and attributes the failure of the Belleville type to the fact that the tubes have the excessive ratio $\frac{L}{D} = 200$. About 25 may be the safe limit, beyond which it is not well to go, and we will not dispute this, though we would point out that the Belleville fault of excess length was complicated, not alone by the numerous bends in the course of each long pipe, but also by the very flat inclination of the many lengths. Steam naturally makes its escape from any confined place along the line of least resistance, and in the Belleville boiler this line of least resistance happened to be the so-called down-comers. These down-comers are short and direct, and the exercise of very little thinking power should have shown designers that they would at once become "up-goers." They did so become, and this virtuous property was denied them by the interposition of the back-flow valves—a ridiculous thing, in any case, to put into a boiler, and serving to aggravate matters, we should suppose, and not to improve them. As constructed without the non-return valves, as, we believe, the boiler originally was constructed, the steam generated in the lower tubes would naturally tend to escape by the so-called down-comers, and one inclines to ask if ever the down-comers were made to extend above the water line in the steam drum. Had they been so constructed, and had the enormous length of tubes not prevented circulation, it is obvious that, with a reversed flow of water down the sloping tubes and up the "down-comers," as steam and water mixed, there might possibly have been a steady circulation of the water towards the fire, the comparatively cold water descending the manifolded tubes, becoming hotter as it neared the furnace, and finally escaping as steam and water by the short path of the "down-comer." Such a circulation would of course have been correct in direction—the water and the hot gas would have flowed counter current wise. But M. Belleville would not have this; at least he interposed his non-return valves, and rendered such a circulation impossible, while not introducing any other true circulation. It is possible, of course, that the generation of steam in so long a tube would be so great that no satisfactory circulation was established. We have no information that a satisfactory circulation was set up, but we are at least justified in assuming that the presence of the non-return valves proves that circulation of a sort did establish itself contrary to M. Belleville's intention, or otherwise why are the valves there? Now we should very much like to know whether such unpremeditated circulation did occur to a satisfactory extent, and whether had it been left to itself, it would or would not have been sufficient and satisfactory. We confess to having doubts on account of the many square bends, but we think it extremely likely that the boiler would have acted better and would have been safer as a free agent, striving to produce a natural circulation, than as arranged with the valves to compel an unnatural direction of flow. We can imagine that the flow which did take place prior to the introduction of the non-return valves comes as something like a shock upon the designer, who took such steps as suggested themselves to compel things to follow the lines of human design and fallibility rather than listen to the voice of nature, whose laws are being defied.

There seems no reason to believe that the ratio of 25 : 1 applies to boilers of small-tube type in which the inclination of the tubes is steep. Such boilers seem to possess excellent circulation, and to demand only good water. Boilers with a single length of inclined tube also seem to have a circulation in the designed direction. If it were absolutely essential that the Belleville boiler should be made a success, it could easily be done. It can hardly be doubted that the interposition of a centrifugal pump between the upper drum and the water-tubes, of a capacity sufficient to compel a circulation of sufficient magnitude downwards towards the fire, and up by the down-comers, would compel success. It is simply a question of facing the mechanical problem, and is hardly likely to be attempted while there are boilers that will remain safe without a mechanically-produced circulation.

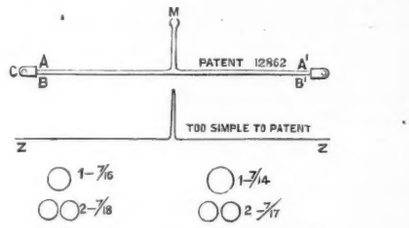
CORRESPONDENCE.

"Jointless" Car Cables.

Patent No. 12,862, June 24th, 1901, has come to my notice, and I beg to ask why great complications should be added to such a detail as wiring a car?

This method proposes to use double the quantity, of half the sectional area, of copper, and by taking out one loop to get a tapping without the usual **T** joint.

I refer to the diagram published, and submit a diagram of cables which I have used for years, and never thought the



method worthy of the cost of patenting. I also put the advantages claimed against the superior advantages of the older and simpler system.

THE JOINTLESS PATENT CLAIMS	MY METHOD USES
Two smaller wires A A' and B B'.	One equivalent wire Z Z.
For ·0256 sq. in. copper two 7/18's, each ·355 in. diam.	For ·0229 sq. in. one 7/16, ·419 in. diam.
For ·0348 sq. in. copper two 7/17's, each ·380 in. diam.	For ·0356 sq. in. one 7/14, ·483 in. diam.

There is not much evidence of economy of space. Number of wires to enter confined space in controller:—

Two.	One.

Size of hole in canvas covering at least

·71 in. × ·36 in. against ·419 diam.
·76 in. × ·38 in. against ·483 diam.

The facility of changing one wire instead of two connected to a double socket is vastly in favour of my method.

In fact, the patent under criticism is another instance of a theorist's work with no provision for getting twice as many cables of practically the same diameter into a hole already too small to get the smaller number in with ease, as every car wireman could testify.

The relative sizes are shown on sketch of cable of sizes mentioned.

L. D. Collins.

London, *January 28th*, 1902.

Gas Producers.

We notice, and as makers of gas producing plants are much interested in, "Enquirer's" letter which appeared in your issue of January 14th, and your remarks thereon in another column.

We do not, however, quite agree with the assumptions contained therein. In the first place, great stress is laid on the advantage of a plant taking up very little room. Is this an unqualified advantage? Of course, we know that in some cases space is very valuable, and compactness of plant may outweigh every other consideration, but we certainly hold the opinion strongly that, where room for it can be found even at some sacrifice, a plant having cleaning apparatus of ample capacity will be cheapest and most satisfactory in the end,

and we certainly consider that the gas holder justifies its existence, if only as a regulator of pressure, especially so, if as often happens, there are burners or stoves working from the same gas plant as the engines, though there are several other reasons in favour of its retention.

It is obviously impossible to clean the gas thoroughly unless the plant has sufficient cleaning apparatus, and this of course takes up room.

With regard to the delivery of gas below atmospheric pressure, and the question of leakage in connection therewith, it is certainly true that if a leak occurs in a plant in which the gas is below atmospheric pressure, air will be drawn in and the gas weakened, and if the plant is working above atmospheric pressure a certain amount of poisonous gas will escape, but this appears to us to be a trivial point, for surely *no* reputable firm would erect a plant with leaky pipes.

The other question raised by "Enquirer" is of far more importance. A certain amount of power will be taken if the piston of the engine has to draw its charge of gas through the plant, though on small engines we imagine that it would be too small to be a serious consideration, but where the real disadvantage lies is in the fact that the engine is drawing its charge at a slight vacuum, and that, therefore, a more attenuated charge of gas is obtained than if it is delivered at a slight pressure above atmosphere, and consequently the power given off by such an engine must be less.

We consider that the power would be at least 5 per cent. less than if gas of equal quality were delivered under pressure to the same engine, and the power obtained from a given engine would probably be 20 per cent. less than with town's gas.

In answer to "Enquirer's" question as to where large engines may be seen working on the Taylor system, you refer to several engines working with blast furnace gases, and state that these gases are practically identical with ordinary producer gases.

This is not the case, nor have we heard of any case where the systems are worked in a manner sufficiently similar to render the results obtained with one of any service in estimating probable results with the other.

Blast furnace gases, although composed of nearly the same constituents as ordinary producer gases, contain them in very different proportions; for one thing the amount of CO_2 (carbon dioxide), which is useless, is much greater, and their heating value may be taken as being from 100 to 120 B.T.U.'s per cubic foot, while the heating value of producer gases, as generated by various types of producer at present on the market, would vary from about 140 to 170 B.T.U.'s per cubic foot.

Again, engines specially designed for the purpose are almost invariably used to work with the very poor gas derived from blast furnaces, and we have never heard that the supply of gas is delivered to them below atmospheric pressure.

We shall be pleased, as far as we can, to answer any further questions "Enquirer" may wish to ask, and thank you in anticipation of your courtesy in inserting this letter.

T. H. & J. Daniels.

Stroud, *January 28th*, 1902.

Improved Testing Tank.

It is not contended that by the use of the improved testing tank the normal conditions can be attained the instant the generator is started up. With whatever form of testing apparatus is used, adjustments must be made until the steady load is attained, but if "Yrreb" will make a small calculation he will find that it will only occupy a very short space of time to raise the temperature of the electrolyte in the tank from, say, 55° F. to 200° F., and during this time an attendant was necessary to adjust the distance apart of the electrodes. Up to the present, the most steady load has been obtained by the use of wire resistances, but this resistance is not constant until the heat lost by radiation is equal to the heat caused by the C^2 R losses, but after the wire has attained a certain temperature one equals the other.

Why, if the load had been continued for another half hour, must the electrolyte have been boiling? What particular virtue is there in the next half hour? A test was made with 300 KW. for 6 hours; at the end of 20 minutes the electrolyte had attained a temperature of 200° F.; the electrodes were not altered in any way, and the test was continued for six hours, during the whole of which time the electrolyte, owing to the cooling action of the circulating water, remained constant at 200° F.; and I am ready to assert that "Yrreb" could have run for another half hour, or half day, without getting the electrolyte to boil.

I entirely fail to see the benefit of "Yrreb's" arrangement. His tank contains 96 cub. ft., and therefore holds 6,000 lbs. of water. Now, 700 B.H.P. will raise this weight of water 5° F. in one minute, so in order to keep the electrolyte at an approximately equal temperature, the tank must be refilled at least 30 times per hour when testing his 700-H.P. set. This is equal to 180 times for a six hours' run, or to 1,140,000 lbs., or 114,000 gallons of water. If he adds no salt or soda, his electrolyte will only be plain water long before he has finished his test.

"Yerreb" is discreetly silent upon the sloppy state of the ground round his tank while the test is in progress, to obviate which was one of the reasons why this tank was made. Neither does he appear to appreciate the fact that with his tank he loses 114,000 gallons of water, while Mr. Lindley saves this, as it was distinctly stated; the water was in no way defiled, but could be, and was, afterwards used for boiler feed.

Provided the tank is properly made, there is no reason why it should not be used for high-tension work.

The Writer of the Article.

The Tramway Junction at Sheffield.

For several weeks considerable space has been taken up in your Journal by a discussion on the above subject, which, in my opinion, does not exactly fall within its province.

The first letter that appeared over the name "Electric" struck me as being, to say the least of it, rather strange from a disinterested individual, so I followed the whole correspondence carefully, and I might say with interest; and if, after his apparent inexperience of tramway matters has been plainly—painfully plainly—pointed out by "P. W. E." and other correspondents, he does not admit that the position he has taken up is untenable, there is an extract from our Immortal Bard that I could mention which he might very appropriately take unto himself.

Dynamo.

[No useful purpose will be served by a further continuance of this correspondence. Readers will therefore kindly note that it is now closed.—Eds. Elec. Rev.]

Machine Tools.

Referring to Mr. Bathurst's letter in your last issue, I note that he says that his articles were designed for the ordinary reader, but it is precisely the ordinary reader who is likely to be misled by Mr. Bathurst's inaccurate statements, as he is not able to add the grain of salt needed for the digestion of all Mr. Bathurst's articles.

The statement (which Mr. Bathurst has not attempted to justify) about the unskilled labourer being able to work a drilling machine as efficiently as the high-class workman, is an instance in point.

As regards the oiling pin in the tail-stock casting, I will refer Mr. Bathurst to *Engineering*, February 17th, 1888, p. 161, where he will see an illustration of the oil-hole and pin, which he says "was evolved perhaps five years ago."

Mr. Bathurst's remark about axe grinding is rather ill-advised, in view of his previous writings on the subject of interior wiring; as a matter of fact, I am not a manufacturer of machine tools.

For the matter of that, Mr. Bathurst himself seems to have set up a new grindstone in these articles, but I am glad to see that he owns that it doesn't put on a very keen edge.

H. W. A.

demand only good water. Boilers with a single length of inclined tube also seem to have a circulation in the designed direction. If capacity will be cheapest and most satisfactory in the

Soldering Fluids.

With reference to the inquiry in your issue of January 24th about soldering flux, it may be of interest for me to say that for three years I used a paste similar to that mentioned by "H. F. T." It was called the "Highland" flux, and I do not know whether it is at present sold in England; like the Burnley paste, it was made in U.S.A. This flux will clean the metal, quite as much as the ordinary soldering fluid, while resin, of course, does not do so to any extent, but only keeps the surface clean if previously cleaned. For instance, when using the paste, it is unnecessary to scrape or emery-paper the wires of V.I.R. insulated cables, which saves a great deal of time, especially with stranded cables; the solder "takes" without difficulty even when the wires are quite black. I have used it for large cables, and for the finest wires, and have never seen the slightest trace of corrosion, though I have opened many old joints. I would also like to point out that a paste is a far more convenient form for using, and for carrying about, than a fluid, or such a substance as resin.

I do not believe that anyone who tried soldering paste would ever want to use resin again as a flux for soldering.

G. C. Allingham.

Hampstead, *February 4th*, 1902.

In last week's issue of the Review, we notice some remarks as to a non-corrosive soldering paste, calling it the Burnley soldering paste.

It will, perhaps, be of interest to many of your readers to learn that *we* are the makers of this substance; the name we sell it under is, "*Electro-Soldine*," and we conclude that the reason it has been named the "Burnley soldering paste" is owing to Burnley being our postal centre, and it having been used largely in that town.

We may say that we have been making this material for many years, although we have only recently pushed its sale.

We are taking the liberty of forwarding per post a few samples, and trust that they will be of service.

Thoroclean Soap Company.
H. Whitaker.

Padiham, *February 3rd*, 1902.

[We have examined the samples, which are of the same consistency, but of a much paler complexion than the samples previously sent us by our other correspondents. Apparently there is some confusion on the question of nomenclature. "Electro-Soldine," it is claimed, is non-corrosive, and free from acids; it is a stiff paste, and can readily be applied to the work with a splint or a knife. We have not as yet experimented with it.

We have received a further sample of the Burnley soldering paste, this time from the London agents, Messrs. E. Home and Co., of Old Charlton. It is of the consistency and colour of vaseline, and appears to be identical with that to which we referred some time ago.—Eds. Elec. Rev.]

"Hatfield" Electrically-Driven Feed Pumps.

Referring to our letter in your last issue, we are sorry to trouble you again, but we find, unfortunately, there were some clerical errors in our last. We shall be obliged if you will kindly correct them.

In the sentence beginning "Assuming the all-round efficiency . . ." the first figure should be 60 per cent., not 50 per cent., and the consumption of steam per B.H.P. per hour of the pumps should be 37, and not 30.

Merryweather & Sons, Limited.

February 3rd, 1902.

The letter in your issue of January 24th from "Station Engineer" is open to much comment, and I am surprised that no one has replied to it. The method employed in locating the H.T. short was, indeed, primitive, and does not reflect much credit upon those concerned. What were the house transformers cut off for? And what is meant by saying that the short could not be tested for with transformers on the feeder? From the nature of the fault when found, it would appear to be a pretty good earth, as well as a short, and could have been located by testing with ohm-meter, and treating the fault as an earth.

It is to be hoped, for the sake of unfortunate consumers, that it was purely a small piece of friction.

Mains.

The Testing and Management of Electric Motors.

Mr. Cramp has assured us that the method advocated by the writer in the American contemporary gives approximate results. In this method the losses referred to are assumed to remain constant from "no" load to "full" load.

The sentence abstracted from one of my articles should be read in the "light" of its own context, and in no other light whatever.

P. T. White.

I suggest that you should refuse to insert letters in your paper from writers who find it necessary to resort to personal reflections and abuse to support their arguments. By resorting to such methods they generally give away their cause, and invariably give away themselves.

G. N. T.

[We are wholly in sympathy with our correspondent, "G. N. T." in his suggestion. Our practice is to allow correspondents a free hand, except when they indulge in libellous statements (for which, of course, we should be held responsible). It is, however, with the greatest regret that we insert such letters as the one complained of, more especially as we are aware that Mr. White's critic, whom he rashly assails, far from being a mere theorist, is a thoroughly practical engineer, fully equipped with experience in the best workshops, and with special knowledge of the very subject under discussion. Further, Mr. White's allusions to the Central Technical College show that he is under a total misapprehension as to the nature of its work and methods. Not only is the college fully up to date in its teaching, which is in the hands of a staff recruited from electricity works, dynamo factories, &c., but the researches carried on in its laboratories have been, and will be, of the greatest value to the electrical industry in general.

Referring to the subject of the controversy, we may say that while we should strongly object to the *wilful* interruption of the exciting current of a shunt-wound motor or dynamo, still, it is an accident to which every machine is liable, and we should regard a machine which would not safely withstand the trial as "no class."

No starter should permit of the shunt being broken under normal conditions, but Mr. White said "remove the 'armature' cable." When this is done, the shunt circuit, which should remain closed through the armature at the moment of switching off, cannot be so closed, and therefore the conditions are not normal; the starter is not to blame for this.

As for hint No. 7, we cannot imagine upon what it is based; it is, of course, totally opposed to the facts.—Eds. Elec. Rev.]

Submerged Electric Lamps.—A correspondent wishes to be referred to any information extant regarding submerged electric lamps, for use in fishing.—Eds. Elec. Rev.

University College, Liverpool.—The Technical Instruction Committee of the Lancashire County Council, after giving careful consideration to an application from University College, Liverpool, for a special grant towards the cost of equipping the Department of Electro-Technics, recommends that a special grant of £1,000 be made for this purpose, such sum to be paid in two equal annual instalments of £500.

ELECTRICAL MATTERS AT THE LONDON COUNTY COUNCIL.

THE Finance Committee reported at a meeting of the Council on Tuesday having received an application from the Electrical Trades Union for increases in the rates of pay for electrical workmen to be made in the Council's list of rates of wages and hours of labour. Having made inquiries, the Committee were of opinion that the wages for armature winders should be advanced from 8d to 9d. per hour, but that the other rates asked by the Union were not those in practice obtained. The Committee were in communication with the Union on the subject, and meanwhile the Council decided to amend the list to 9d. per hour for winders.

Provisional Orders.—The Highways Committee presented a report in relation to the five applications made to the Board of Trade for provisional orders by the Borough Councils of Bermondsey, Camberwell, Southwark, Stoke Newington, and Woolwich. As regards the charge for supply, the maximum price fixed in four of the orders was 8d. per unit, whilst in the Southwark order the price specified was 10s. for any amount up to 20 units, and 6d. per unit above that quantity. A year ago the County Council suggested, in the case of the orders then before the Board of Trade, that the maximum price after the first 20 units should be 5d., which appeared to be the average charge to consumers. The Board of Trade, however, after holding an inquiry into the matter, inserted in such of the orders as were granted last year 10s. as the maximum price for the first 20 units, and 6d. per unit after that number. As already stated, 6d. was the charge proposed in the Southwark order of this session, and the Committee expressed the opinion that the Board of Trade should be asked to insert the same maximum in the other orders. They had prepared amendments to give effect to that suggestion, and to other amendments of a formal character.

The Telephone Service.—A report was submitted by the Highways Committee in reference to the Guildhall conferences and the futile amendment moved by Sir Joseph Dimsdale in the House of Commons. In commenting upon the question, the Committee stated that there did not appear to be any prospect held out in Mr. Chamberlain's speech of an immediate and careful reconsideration of the terms of the Post Office agreement, such as the County Council had probably hoped for, and the necessity for which was recognised with such general unanimity at the conferences held to consider the subject. Mr. McKinnon Wood asked the chairman of the Committee if he would be willing to postpone the consideration of the question for a week, in view of the facts which had now come before the Council. The discussion was thereupon deferred.

Subways for Tramways.—The Improvements Committee, in reporting on the Victoria Embankment—Holborn subway scheme, mentioned that one of the points to which much attention had been given, was the proposal for bringing the contemplated underground tramway to the surface in Southampton Row close to the junction with Theobald's Road, and the effect which the scheme would have upon existing traffic at that and similar places. The subject was so important, however, that there had not been sufficient time for the Committee to examine alternative schemes and to have full estimates of the cost prepared. In the opinion of the Committee the Bill should be proceeded with in its present form on the understanding that before the work was undertaken they would have an opportunity of considering any suggestions for the modification of the project. In a further report of considerable length the Committee referred to the proposal for the widening of the southern end of Hampstead Road, the refusal of the St. Pancras Borough Council to consent to a tramway along Tottenham Court Road, and the suggestion of that authority in favour of a shallow underground tramway being constructed under that thoroughfare. With regard to the latter suggestion, the Committee pointed out that the Metropolitan Railway, which passes under Euston Road and across the junction of Hampstead Road and Tottenham Court Road, would cause insuperable difficulties to the construction of a *shallow* underground tramway from Hampstead Road to Oxford Street passing under Euston Road. The underground tramway would either have to come to the surface before it reached Euston Road or would have to pass under Euston Road in tunnel, the tram rails being probably about 40 ft. below the surface at that point, and this would be very inconvenient if a station were required there. Moreover, there would be difficulties in connection with the drainage. If, on the other hand, the tramway were brought to the surface south of Euston Road a widening of Tottenham Court Road would be necessary, involving the acquisition of valuable properties at considerable cost. The construction of an underground tramway along Tottenham Court Road would involve an expenditure of from £300,000 to £400,000, and this estimate does not make any allowance in respect of compensation which might have to be paid to the owners of vaults or cellars under the footways which would have to be interfered with if such a tramway were constructed, because on each side of the tramway-subway there would be a subway for pipes, wires, &c., the total width of the space to be occupied by the three subways amounting to about 50 ft.

The Committee stated that the difficulties had been explained to a deputation from the Borough Council which would probably have to reconsider the question. In the meantime the Committee recommended the Council to proceed with the clauses of the Tramways and Improvements Bill relating to the widening of Hampstead Road on the understanding that a clause should be inserted to provide that the carrying out of the improvement should be subject to the Borough Council giving consent to the construction of a tramway from the present terminus in Hampstead Road to a point near Oxford Street. The recommendation was passed without comment.

BUSINESS NOTES.

Electrical Wares Exported.

WEEK ENDING FEB. 5TH, 1901.		WEEK ENDING FEB. 4TH, 1902.	
Adelaide	Value £1,200	Adelaide	Value £100
,, Teleg. wire	187	Amsterdam	65
Alexandria	211	Batavia. Teleg. mat.	45
Amsterdam	110	Calcutta	940
Auckland	122	Cape Town	488
Boca	978	Channel Islands	100
Bombay	423	Colombo	55
Brisbane	40	Copenhagen. Teleg. wire ..	173
Buenos Ayres	203	Durban	398
,, Teleg. mat. ..	380	East London	273
Calcutta	354	Fremantle	337
Cape Town	141	Hamburg	77
Chinde	31	Havre. Teleg. mat.	65
Colombo	200	Madras	200
Copenhagen. Teleg. wire ..	173	Port Said	50
Demerara	55	Santos	43
Durban	438	Shanghai	200
,, Teleg. apparatus ..	607	Stockholm	119
East London	1,250	,, Teleg. mat. ..	195
Fremantle	18	Sydney	3,167
Hamburg. Teleg. mat.	400	Wellington. Teleg. mat. ..	385
Hobart	80	,, Teleph. mat. ..	246
Hong Kong	17	Yokohama	25
Huelva	27		
Malta. Teleg. mat.	111		
Melbourne	607		
,, Teleg. mat. ..	494		
Newcastle	33		
Ostend	180		
Perth	92		
Port Elizabeth	217		
Rosario. Teleg. mat.	119		
Santos. Teleg. mat.	337		
Shanghai	189		
Singapore	35		
Sydney	1,447		
,, Elec. detonators ..	149		
,, Teleg. mat.	247		
Syra. Teleg. cable ..	24,000		
Valparaiso	233		
Wellington	51		
Yokohama	75		
,, Teleg. cable ..	517		
Total ..	£86,680	Total ..	£7,741

Foreign Goods Transhipped.

Bombay. Elec. machinery	Value £120
Perth. Elec. apparatus ..	.. 35
Sydney. Teleph. apparatus	.. 73
Total ..	.. £228

American Machinery for the British Westinghouse Works.—The *Mechanical Engineer* says that at the Manchester Association of Engineers' annual dinner Mr. J. C. Stewart, the present representative of the British Westinghouse Company in Manchester, said that 80 per cent. of the machinery for the company's works in Trafford Park was coming from the United States, and 20 per cent. from this country. They were importing machinery from America at 40 per cent. less cost than they could purchase it for in Great Britain. The mistake which the majority of the heads of engineering firms made in this country was, that they did not appreciate the advantage of scrap iron. They built machines to last too long. In America they only built their machines to last 10 years, because experience had proved that in every 10 years there was an entire change in machinery; and it was necessary, if they were to enter successfully into competition with others, to at once adopt all the latest improvements.

Arc Lamp Trimming.—The Borough Council of Battersea has just purchased a novel apparatus to facilitate the cleaning and keeping in order of the electric lights in the streets of their district. This is practically a light telescopic fire escape, with special fittings for resting against the lamp standards, and a rising platform at top, on which the workman can safely stand, with both hands free while putting in carbons, cleaning globes, &c. The machine has been designed and constructed by Messrs. Merryweather, the fire engine makers, who have also recently built nine similar apparatus for the Westminster Electric Supply Corporation.

Aston Distribution Boards.—In our notice last week of the new H.V. distribution boards which are being manufactured by Veritys, Limited, a printer's error made us say "Ashton" for Aston.

Bankruptcy Proceedings.—A receiving order having been made on January 21st against Geo. Willie Clarke, electrical engineer, described as of 117, Queen Victoria Street, City, and of Lyndhurst, Harold Wood, Essex, the first meeting of creditors was held at the London Bankruptcy Court on February 3rd, before Mr. W. P. Bowyer, Assistant Official Receiver. The proceedings were founded on a petition presented by the Hiram Maxim Lamp Company, Limited, the act of bankruptcy being the execution by the debtor of an assignment for the benefit of his creditors generally. The chairman said that some difficulty had arisen in the matter, because a receiving order had also been made against the debtor in the Chelmsford County Court. He understood, however, that the two matters would be consolidated, and would be dealt with by the High Court. The debtor had submitted a statement of affairs showing liabilities £5,269 17s. 1d., of which £3,373 5s. 2d. was expected to rank, and assets consisting of stock-in-trade (cost £500), £205; trade fixtures and fittings, £10 10s.; share of deposit in the Post Office, £14 10s.; book debts, £201 11s. 6d.; and surplus from securities held by creditors, £13; total assets, £444 11s. 6d. The

preferential claims were returned at £129 11s. 11d. leaving an estimated deficiency of £3,058 5s. 7d. The debtor had not yet been preliminarily examined under the proceedings.

Replying to the chairman, the debtor stated that he had no offer to make at the present time, but one would be put forward later. The creditors resolved that the matter should be wound up in bankruptcy by Mr. Arthur Fk. Lovell, C.A., of 60, Watling Street, City, as trustee, and they appointed a committee of inspection, consisting of Mr. F. Stokes (representing the Hiram Maxim Lamp Company), Mr. Allwood (of the General Electric Company), and Mr. E. Eggiman. The trustee's bond was fixed at £500. The public examination has been appointed for March 5th at the London Bankruptcy Court. The deficiency account shows an excess of liabilities over assets on January 1st, 1900, of £1,500; household and personal expenses since that date, £300; loss incurred in paying out partner at East Hanningfield, £900; loss incurred through a claim of £100 by the rector of Hanningfield for breach of contract and law costs, £200; loss on business at Grays, £100; and depreciation on fixtures and stock at Harold Wood, £345. On the other side appears net profit on business since January 1st, 1900, £206. The following are returned as creditors:—

Berliner Telephone Manufacturing Company, London	£16	8	0
Bratchell, E. G., Hornchurch	42	8	0
British Electrical Manufacturing Co., Limited, London	21	0	0
Clarke, W., East Hanningfield	1,915	0	0
Durham, E., Chelmsford	14	14	1
Edison & Swan United Electric Light Company, London	27	11	5
Eggiman, E., London	101	5	0
Fuller, McLeod & Co., Limited	30	12	2
General Electric Company (1900), Limited	126	5	8
Hill & Co., Romford	24	0	0
Hiram Maxim Lamp Company, Limited, London	107	12	6
Krupka & Jacoby	51	11	1
Lewis, Bayliss & Co., Wednesbury	256	9	3
Meikle, R. B., London	10	0	0
Renewable Electric Lamp Company, Limited	15	14	9
J. R. Roberts' Stores, Limited, Stratford	10	12	10
St. Helens Cable Company, Limited, Warrington	10	15	3
Spencer, J. E. & S., London	11	9	2
Tanner, W., & Co., Chelmsford	50	0	0
Veritys, Limited, London	17	0	0
Wright, Geo., Chelmsford	370	0	0
Sada, J., & Sons, Limited, Maddon	10	0	0
Fully Secured.			
Huddleston, Percy & Co., London	£117	0	0
Meeson, W. M., Battlebridge	1,650	0	0
Rent	46	0	0
Rates, taxes, and wages	83	11	11

Catalogues and Lists.—Messrs. F. C. Mathieson and Sons, 16, Copthall Avenue, E.C., have published (2s. 6d.) the 1902 issue of their very useful "Highest and Lowest Prices," in which we find details respecting the highest and lowest business marked in 1901, the dates on which they occur, and the extreme fluctuation of every stock officially quoted on the Stock Exchange. The gas and electric, telegraph and telephone, and tramways and omnibus sections are those which will especially appeal to electrical investors and all interested in the business done on 'Change in electrical undertakings during last year.

Messrs. Estler Bros. send us an illustrated list of their Wilkinson's patent trolley head, both swivelling and fixed types; also briefly describing insulating sleeves, trolley wheels, and poles. The swivelling head consists of a sleeve which can easily be clamped on the trolley pole in the usual manner, and on to this sleeve a special bearing arm is fixed by means of a steel pin. This bearing is normally held in position by a suitable spring. Into this bearing the pin of the wheel fork is fitted, and the pivot seating at the bottom is so arranged that the trolley wheel always tends to come back into line with the pole. The trolley wheel is as usual provided with graphite bushing. Should the head leave the trolley wire from any cause, and come into contact with a span wire, the wheel is pulled back, and so allowed to clear itself, after which the wheel immediately rights itself. This head is claimed to embody various improvements, which do not increase its weight.

The English Electric Manufacturing Company, Limited, of Preston, have issued a new brochure, a copy of which has come to hand from Messrs. Dick, Kerr & Co., Limited. There are some excellent pictures made from recent photographs of the different departments at the works, and some of these give a good idea of the large amount of work in hand.

Catalogue No. 43 of Messrs. R. W. Blackwell & Co., Limited, details a number of their specialities, including the Whitney measuring instruments, motor and dynamo rheostats, switches, fuses, and Packard lamps. Prices and illustrations are given.

"A Few Words as regard Size of Steam Pipes," is the title of a little folding list received from the Pulsometer Engineering Company, Limited.

A good list of portable accumulators, lamps, cycle lamps, X-ray sets, ignition batteries, electric jewellery and so forth, has been brought out by Messrs. C. A. Vandervell & Co., of Thorpe Works, North Kensington, W.

Lists of the Regina economic arc lamp (system "Rosemeyer") with current wholesale prices have been issued by Regina-Bogenlampenfabrik, of Köln am Rhein.

From Messrs. Herbert Morris & Bastert, Limited, of Empress Works, Loughborough, an illustrated circular of overhead hand cranes, of which we understand they keep large stocks in different sizes for power stations, engineering works, and other purposes. An overhead electric travelling crane is shown in course of erection.

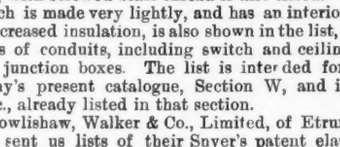
A nicely got-up book (113 pages) has been sent to us by the firm of Ludw. Loewe & Co., Limited, of Farringdon Street, E.C., in which are described the machines manufactured by the Bullard Machine Tool Company, of U.S.A., for whom they are sole agents for Great Britain. The printing, illustration, and general set-out of the book are excellent.

The General Electric Company (1900), Limited, have brought out a new list of "Union" enamelled steel conduits. The company no longer confine themselves entirely to the close-joint light-gauge bedstead type of tube, although this is listed for those who wish to use it, especially for the Colonies and in dry climates. They have made a speciality of a better form of brazed-joint light-gauge tube for butting, but for those who prefer it perfectly watertight it can be supplied in a heavier gauge screwed gas thread. This is a serviceable type of conduit, especially suitable for damp places and for good continuity. For those who require a system of a substantial nature, such as for public buildings, &c., the welded-joint heavy-gauge tubing, with screwed gas thread, is recommended. As it is the practice nowadays to obtain good continuity with conduit, and to connect same to earth at some point, in case of a leak, close-joint tubing with screwed brass thread is also listed. "Papristeel" tubing, which is made very lightly, and has an interior lining, thus affording increased insulation, is also shown in the list, as are fittings for all forms of conduits, including switch and ceiling rose boxes and special junction boxes. The list is intended for insertion in the company's present catalogue, Section W, and it cancels all conduits, &c., already listed in that section.

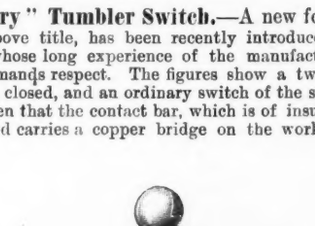
Messrs. Cowlishaw, Walker & Co., Limited, of Etruria, Stoke-on-Trent, have sent us lists of their Snyer's patent elastic clutch or coupling, and of firms to whom they have been supplied.

The North British Rubber Company, Limited, of Edinburgh, has issued reduced and amended price lists of machine belting, also delivery, suction, and steam hose.

"Century" Tumbler Switch.—A new form of switch, under the above title, has been recently introduced by Mr. A. P. Lundberg, whose long experience of the manufacture of electric fittings commands respect. The figures show a two-way switch of this pattern, closed, and an ordinary switch of the same type, open; it will be seen that the contact bar, which is of insulating material, is double, and carries a copper bridge on the working end, which



makes contact with two springy copper plates connected with the terminals. The novel feature consists in the mounting of the contact bar, which is controlled by two springs, and is held in position by a fixed pivot passing through a metal-bushed slot in the contact bar. The combined action of the springs and slot passes description in words, but the result is a peculiar movement of the bar, giving a very quick break, and ensuring definite on and off positions. The handle is insulated from the live parts, and the latter are well separated from one another and from earth. The two-way switch is of similar design; other patterns are made with fuse terminals (which are still called for, even at this date), and with small base for flush work.



The Cruse Superheater.—We have received a well-got-up catalogue of this new superheater which contains a large amount of special information and figures relative to the properties of steam and other figures useful to the steam engineer. The Cruse superheater is novel in construction, being made of fairly large pipes of weldless steel with small internal pipes of copper, through which water is circulated. It is claimed that with this superheater fitted to a boiler, more steam can

be produced superheated to 500° than could be given by the same weight of coal burned in the same boiler without the superheater. This is in accordance with other experience of superheaters on somewhat parallel lines. Applied to a Lancashire boiler, the apparatus is placed in the down-take immediately behind the boiler. There is no space between the boiler and the superheater for the gases to get away. This we consider necessary to the efficient working of superheaters in this position. At the same time it is rather against full inspection, and it may be asked, Why not set back the superheater and apply suitable removable baffle plates to compel the hot gases to travel between the pipes? From the preliminary treatise on superheating it appears that Trevithick, as in other things, was ahead of his time, and patented and made a superheater as early as 1811, for which he claimed great economy. It is claimed for him that he was the originator of the jacket which formed a steam thoroughfare, and he supplied superheated steam to this jacket, whence it passed forward to the cylinder. It is not generally understood or recognised that, with a fixed cut-off to any engine, less work can be got out of that engine with superheated than with saturated steam. This catalogue or treatise does recognise this. The reason is, of course, that so much of the saturated steam is condensed upon entering the cylinder, that the real cut-off is later than it appears to be by the mechanism. Perhaps one-third of the entering steam is condensed, and much of this condensed steam, the latent heat of which has gone to re-heat the cylinder metal, re-absorbs heat from the cylinder as the pressure falls, and helps to raise the pressure during the later parts of the stroke, filling up the toe of the indicator diagram at the expense of the next lot of initial steam. This superheating must be accompanied, for equal work, with a later cut-off, but very much less weight of steam will be used for equal work. The Cruse superheater seems to be constructed on sound principles. Excessive degrees of superheat are perhaps not called for. The principal economy is probably derived with the first 100° of additional temperature, and whatever is found to be the best for general comfort in working, can be secured with the Cruse system of regulation. For varying loads, we think the simple engine and superheater should prove far more economical than the present over-cylindered compound engines that seem to be put to this work, purely because of fashion, and not from either judgment or experience.

Books Received.—"Bryne's Guide to Company Formation." Second edition. Edited and compiled by James Bryne. London: Bryne & Co., Limited. 2s.

"Les Tramways Électriques," by H. Maréchal. Paris: Ch. Béranger. 1902. 10 fr.

"Pumps: Their Construction and Management," by P. R. Björling. London: P. S. King & Son. 3s. 6d. net.

"Export Merchant Shippers' Directory," for 1902. London: Dean & Son. 17s. 6d.

"The Arithmetic of Electrical Measurements," by W. R. P. Hobbs, R.N. Revised by Dr. R. Wormell. Ninth edition. London: Thos. Murby.

Bremer Arc Lamp.—A New York exchange says that the Bremer arc lamp, which uses special carbons carrying metallic salts, &c., and has special features of regulation, has been taken to the U.S., and is now in the hands of the Westinghouse Company. It is broadly understood that coloured lighting effects obtainable are one of the features.

B.T.H. Ampere-Hour Meters.—The British Thomson-Houston Company, Limited, of Rugby, have just secured a record order for 1,800 of their well-known OK. ampere-hour meters. These meters are manufactured for use on standard potential continuous current two and three-wire circuits only, and in capacities of from 1 to 15 amperes inclusive. They are stated to start with less than 1 per cent. of the full-load current, thus ensuring a high degree of accuracy on the smallest load which the instrument is expected to record. Some of the prominent features claimed for this meter are: Small size, neat appearance, small cost, high accuracy, permanency, minimum of attention required and negligible temperature coefficient.

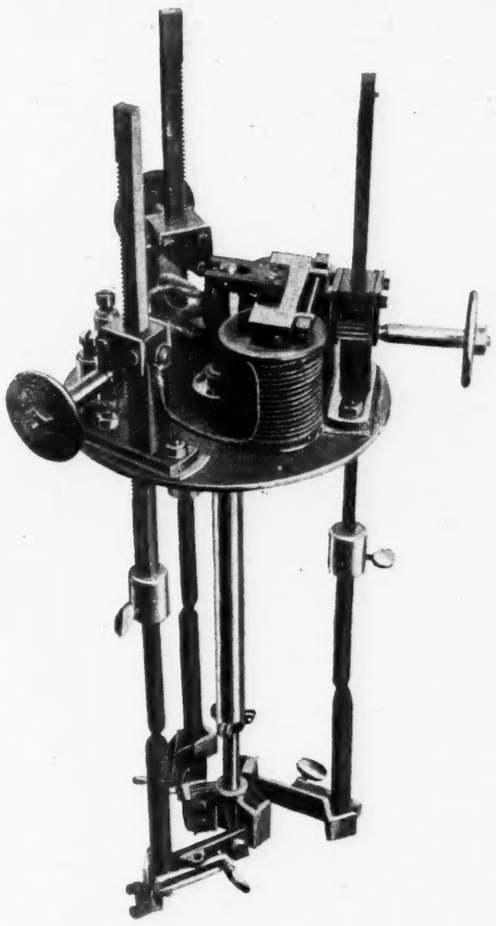
Concert.—The Thomson-Houston Athletic Club held a Bohemian Concert at the Town Hall, Rugby, on Friday, January 31st, this being the first since the removal of the company from London to Rugby. The chair was occupied by the managing director of the company, Mr. W. J. Clark. The concert was an unqualified success, and the limits of the hall were severely taxed to accommodate the large and appreciative audience present. So successful was this concert, that the Committee now believe they have every reason to feel justified in holding several similar gatherings during the season.

Directory.—We have received a copy of the 1902 edition of the "Export Merchant Shippers' Directory" (Dean and Son, Limited, 160A, Fleet Street, E.C.). We understand that the whole book has been carefully revised, each section having been considerably enlarged; especial attention has also been given to the lists of merchant shippers and classified goods shipped, and it should be a useful book to commercial men who want at hand, for ready reference, a concise list of shippers, manufacturers, and agents, arranged under their different towns. The price is 17s. 6d.

Düsseldorf Exhibition, 1902.—A great Industrial and Art Exhibition will be held at Düsseldorf in May. Düsseldorf is the chief centre of the iron and steel industries of Germany, and it is anxious to emulate the example of Glasgow; but, unlike Glasgow, its exhibition will not be international. The German manufacturers intend to demonstrate by this exhibition the great progress that they have made during the last 20 years. Everything has been organised on a large scale. There is a Machinery Hall covering five acres, and it will contain all the latest inventions in engineering and electricity. The Great Industrial Hall occupies 7½ acres. Düsseldorf will be the national meeting-place in Germany during the exhibition for all scientific and other societies. The British Iron and Steel Institute will hold its annual meeting in the city, and there will be other important international gatherings.

E.C.C. Beneficence.—The Electrical Construction Company, of Bushbury, near Wolverhampton, have offered a recreation ground to the Bushbury Parish Council, and at a meeting of that Council on Friday evening last, a deputation was appointed to wait upon the manager of the company (Mr. Blackburn) to arrange about taking the ground over. The chairman and directors of the company were also heartily thanked for their generosity.

New Arc Lamp.—The accompanying illustration shows a new arc lamp which has been designed by Messrs. Offord, Wilson and Barfield, of Birmingham, and is now being manufactured by them specially for use in photographic studios. The lamp is intended for fixing to the usual parabolic reflector, and is made either with two, three or four sets of carbons as may be most convenient for the E.M.F. at disposal. It is primarily arranged to substitute a single lamp taking, say, 30 or 40 amperes on 100-volt supply whenever the supply in that place is changed over to, say, 200 volts, as by having three or four lamps in series as shown, large losses in resistances are avoided. This arrangement is provided with an automatic striking gear, so that immediately the last set of carbons are fed together by hand, the arc is struck on all three or four lamps simultaneously. A specially strong and portable resistance frame is also made, to be run in conjunction with these lamps.



Flash Light.—At Westminster Police Court last week, a new electrical sign was condemned by the magistrate on the score that it came within the words of the bye-law—"altering suddenly in intensity." It was given in evidence by Mr. G. C. Fricker, an electrical engineer, that the sign was specially designed to comply with the regulations, and that the gradual variations from minimum to maximum brightness, and back again, occupied three-quarters of a minute. Nevertheless, this learned magistrate—Mr. Sheil—declared that he would accept the opinion of practical men like 'bus drivers before all the engineers in the world, and he cared not a straw for the views of "scientific persons who speak of seconds." We now know that to speak of seconds is to be scientific—truly a short cut—and that practical wisdom is to be found on the box. Would that it could be found on the bench!

German Electrical Industry.—The financial papers say that the possibility of the establishment of a community of interests between the Allgemeine Elektricitäts Gesellschaft, Berlin, and the Schuckert Electrical Company, of Nuremberg, is considered to be favourable. Members of the board of the Schuckert Company are expected shortly in Berlin, in order to more closely examine the circumstances of the Allgemeine Company, but some time will elapse before the arrangement has been completed.

Guildhall Charge.—Last week Alderman Smallman had before him Charles Bright, electrical engineer, of Buenos Ayres, who was charged on remand with having unlawfully, with intent to defraud his creditors, concealed some of his property, namely, 10,202 shares in Charles Bright & Co., Limited, and 13,183 shares in Bright's Light and Power Company, Limited. Two other persons were now summoned—Moreno and Fudge—who were charged with conspiring with Bright to commit the alleged frauds. The Alderman adjourned the case, and said that Bright's bail would remain as before. Fudge and Moreno would each be released on their own recognizances in £500.

Mica in 1901.—In their annual mica trade report Messrs. Tulloch & Co., of 4, Fenchurch Avenue, E.C., state that during 1901 mica suffered from the prevailing general depression in trade. At the close of the year the outlook became more promising, but no material improvement in values was expected until more active purchasing took place in the electrical and other trades. We make the following extracts from the report:—

In Germany the commercial crisis has accentuated the depression in the electrical trades. As that country is one of the largest customers for Indian mica, this has slackened demand generally, especially as regards the larger-sized slabs. Whilst the European demand all round has been quiet, stocks of good useful sizes and qualities have been in short supply, and should inquiries continue to run on medium grades and the larger remain neglected, it is not unlikely that values for the smaller sizes will go to a premium. Nature has, unfortunately, not arranged the mica crystals in convenient lots of graded sizes. Thus, taking Bengal mica at the present time, there is no incentive to either the European or native mineowners to work their deposits to their full capacity. The grades at present mostly sought after are, perhaps, Nos. 3, 4 and 5, latter either in the form of slabs or splittings. To provide these grades means also the mining of the larger crystals and the accumulation of stocks of the very sizes for the sale of which the mines mainly depend for their profits. These remarks apply specially to Bengal, but also to Madras in a lesser degree. Unless the trade go back to a larger extent on the larger sized grades, or some fresh use is found for same, mining can only be carried on at a loss, and this is bound to curtail exports from India and Calcutta especially. Canada has exported a rather larger quantity to the United Kingdom and Continent, but this description does not attract much support at present from the electrical trades. Stocks in London in importers' hands of good quality and useful sizes are light—smaller indeed than for some time past.

To sum up the position. Whilst the important developments in electrical traction point to an even larger consumption of mica in the near future, other countries outside of India have been attracted to compete and exploit their own deposits. Notably is this the case with Canada, which country supplies approximately three-fifths of the American mica consumption. Bengal miners, who are somewhat conservative in their methods, have to "wake up" and recognise this fact, and that the trade here is in a transition condition. Hundreds of cases are every year exported from Calcutta of qualities absolutely unsaleable, and which not only mean a heavy loss to shippers, but help to prejudice the selling values of good merchantable qualities by unduly inflating stocks on the London market.

Trade Announcements.—Messrs. Geipel & Lange, of Westminster, have (as successors to Messrs. H. M. Salmony & Co.) been appointed the sole agents in the United Kingdom and English Colonies for the sale of the electrical testing and measuring instruments made by Messrs. Chauvin & Arnoux, of Paris. These instruments have been widely used both in this country and upon the Continent, for many years. Amongst others are included:—Ammeters and voltmeters (switchboard and portable types) of the gravity, moving coil, and hot wire patterns; also recording ammeters, voltmeters, and wattmeters of the D'Arsonval and hot-wire patterns; portable testing sets of all descriptions, including ohmmeters, Wheatstone bridges, potentiometers, galvanometers, and universal testing sets. Of the last mentioned, they supply a special line of combinations of instruments enabling any reading over a very wide range to be made by the station engineer at any portion of his system. We learn that already these sets are in use at 20 different stations in this country. Messrs. Geipel & Lange propose holding a stock of the most used patterns in London, and can give prompt delivery. They will shortly be issuing a complete catalogue.

The E.L.B. (British Manufacturing Company), Limited, announce that as extra accommodation has now been made available at their registered office, 7, Pall Mall, S.W., the counting house has been removed to that address. No. 9, Grosvenor Mansions will therefore be devoted entirely to sales.

Messrs. Ellis & Ward, electric light and power engineers, of Birmingham, have taken extensive offices, showrooms, and stores at Edmund Street, Birmingham, in order to deal with their rapidly increasing business, where they will hold large stocks of dynamos, motors, and other machinery and fittings for electric light and power distribution, available for immediate dispatch, and suitable for alternating or continuous-current circuits of all standard voltages.

ELECTRIC LIGHT AND POWER NOTES.

Ashtead.—The Epsom R.D.C. has assented to the application of Messrs. Baker, Lees & Co. for a prov. order relating exclusively to Ashtead Parish.

Bath.—The sub-committee appointed to inquire into the breakdowns at the end of last year has presented its report to the T.C. The sub-committee finds that the accidents were but extreme instances of similar occurrences which took place at intervals from the time when the Corporation took over the works, and were mainly due to the defective system in vogue, viz.: high pressure alternating current of high frequency, not running in parallel, but using throw-over switchboards and an obsolete system of mains. At the time of the purchase the consulting engineer, Mr. R. Hammond, advised that no alteration was necessary in the system, but that an expenditure of £14,503 (later increased to £32,500) would suffice to put the works and mains into a satisfactory condition. The Committee in charge of the matter pressed the scheme through the Council with undue haste, without obtaining a further report from the engineer, and continued to incur large additional outlays from time to time until the total expenditure amounted to £95,000. The old switchboard was condemned by H.M. inspector in May last year, but the warning was ignored, and on the advice of their engineer the Committee obtained a new board of similar design, which failed the first time it was put into use, and caused an extinction of the light throughout the city. Immediately upon taking charge of the works, the resident engineer, Mr. Teague, recognised the danger of both the boards, and obtained a design and estimate from Messrs. Ferranti, Limited, for a new switchboard, which were submitted to the committee, but nothing further was done until the recent breakdowns compelled the committee to procure a similar Ferranti board in haste. The latter is one-fifth the size, and two-thirds the cost of the new board which broke down.

The engine-room crane is useless for handling the new engines, as it is not mounted at a sufficient height. The meters in use are said to be of an obsolete type, and no meter testing apparatus was provided at the works until last July. The switches ordered for the arc lamp-posts in 1900 at £5 10s. each, never have been, and never can be, used.

The Committee is convinced that the series of accidents at Bath is in no way a necessary accompaniment of electricity supply. Examination of other undertakings proves that they are safe and profitable investments. A subsequent report will be devoted to the question of street lighting, and to discussion of the best course to be pursued in the future.

Mr. Manville, who has been called in to advise the Council, recommends a further outlay of £70,000, and estimates that after reconstruction the undertaking will return £300 per annum in addition to capital charges and working costs.

Mr. Manville, in his report, makes the following recommendations:—

That (for the centre of the city at least) the direct current (instead of the alternating) should be adopted. This would give such satisfaction to consumers that a rapid increase in their number would ensue.

That the authority should avail themselves of the opportunity of the change of system in the central portion of the city to raise the pressure both there and in the outskirts to 220 volts at consumers' terminals. The immediate effect of this would be to enable the low tension network in the centre of the city, which is at present overloaded, to take for the most part at least three times as many lamps as at present with efficiency.

That the existing plant in the station should be left exactly as at present.

That the first section of a new boiler house be erected, so designed that ultimately coal-bunkers could be erected overhead; that it be fitted with two marine dry-back boilers (space being left for six).

That two turbo-generators, each of 250 KW., and two, each of 500 KW., be installed forthwith, and also an alternator, switchboard and other apparatus.

His estimate is as follows:—

Building, including chimney shaft 150 ft. high	£10,000
Two new boilers	9,700
Four turbo-generators and alternator	17,154
Switchboard	2,500
Mains	14,966
Cost of connecting additional consumers to take up 23,800 8-c.p. lamps	2,200
Substitution of 104 existing public lamps	624
Feeder switchgear	400
Altering incandescent lamps for higher pressure	2,500
New meters	1,500
Ferranti switchboard	1,400
Equal ratio transformers	1,000
	£63,944
Contingencies and engineering, say 10 per cent.	6,394
	£70,338

On the assumption that there are additional consumers to the extent of 23,800 lamps, in future there would be a gross profit of £10,245.

The interest and sinking fund on present capital expended (£95,730) is £5,732, and on the proposed further expenditure of £70,000, would be £4,200 more, making a total of £9,932, leaving a net annual surplus of £312. The extra number of lamps, on which the calculations are based, may be obtained in three years.

Mr. Manville proposes to make a supplementary report, stating how the overloaded condition of the plant and mains may be dealt with.

Ballymahon.—A public meeting of the people has approved of a scheme for the electric lighting of the town.

Belfast.—The output of electrical energy for the past half-year shows an increase of 30 per cent., made up of lighting 20 per cent., and power 97 per cent.

Bridgend.—On Tuesday night the Bridgend U.D.C. affixed their seal to an agreement with the South Wales Electrical Power Distribution Company to supply the town with electric light. An electric tramway is now on the *tapis* for the district.

Bridgwater.—The B. of T. has revoked the Bridgwater Corporation Electric Lighting Order, 1898.

Brisbane.—An electrical crane for the wharves at South Brisbane is expected to arrive in Queensland about the end of March next. It will be able to travel along the wharves, pick up a truck of coal, lower it into a vessel's hold, and discharge the coal in the quickest space of time.

Bristol.—The Electrical Committee are making arrangements for the ceremony of opening the new lighting station at Avonbank on Wednesday, February 19th.

Broughty Ferry.—The T.C. has agreed to appoint Mr. G. Balfour, electrical engineer, Dundee, to report on the whole subject of starting an installation of electric lighting for the burgh. Mr. Balfour was selected from a list of fully 20 applicants in Scotland and England.

Colliery Plant.—The Hulton Colliery Company, near Westhoughton, are having electrical machinery put down in two new mines they are about to open near Atherton, Lancashire.

Dorking. — The U.D.C. has rejected the offer of Edmundson's Electricity Corporation to take over the Council's prov. order for 25 years on the Council applying for a loan of about £39,000. The Council, however, is ready to negotiate with the applicants or any other firm.

Dacca (India).—The electric lighting installation provided for the town by the generosity of the Nawab, Sir Ahsanullah Bahadur, was opened on December 8th. It was carried out by Messrs. Osler & Co., at a cost of 4 lakhs of rupees. The plant consists of three Marshall loco-type boilers, four Belliss-Parker steam dynamos, and a storage battery, and is capable of supplying 2,500 8-C.P. lamps.

Edinburgh.—The T.C. has received the consent of the Secretary for Scotland to the borrowing of a further sum of £90,000 for the erection of electric lighting works, raising the total sum to £790,000.

Farnham.—The U.D.C. has asked Messrs. Preece and Cardew to recommend other firms, in addition to Messrs. Edmundson's Electricity Corporation, to submit competitive tenders for the electric lighting scheme.

Gillingham.—The D.C. has resolved that application be made to the L.G.B. for permission to borrow £58,000 in respect of estimated capital expenditure on the electricity works to be acquired by the Council.

Greenock.—The burgh electrical engineer, Mr. W. M. Nelson, points out an error in the output figures which we gave last week. It seems that the figures should be as follows:—

	Units sold.
1901 (52 weeks), lighting	280,263
" traction	126,195
Total	406,458
1900 (52 weeks), lighting	150,642
Total increase	255,816

Our previous information made it appear that 280,263 units was the *total* output, whereas it was the output for light and power only. As the tramways did not attain the full service until November 7th, and a very large proportion of the motor load (370 KW.) came on in November and December, it is evident that even these figures do not really represent the actual state of affairs, and there will consequently be a very large increase in the output for both lighting and traction during the current year.

King's Lynn.—The Electric Lighting Committee have entered into an agreement with the Guardians to wire the workhouse for £148.

Leeds.—During the last quarter electric lamps were added equivalent to 20,000 8-C.P. lamps, compared with an increase of 8,000 during the corresponding quarter of the previous year. The E.L. department is now able to supply 170,000 such lamps.

The new electric mains now being put down in Long Road promise to turn out a most profitable investment, scores of applications for lights having already been received from shopkeepers and householders in that district.

The demand for electricity for motive power is rapidly increasing. Two large orders for over 100 H.P. each have just been received by the department from two big engineering firms, one of whom intends running his establishment entirely by electricity.

The extensive new generating plant now being put down in the old Brittania Mills is expected to be ready in six or eight months.

Llanelly (Carmarthenshire). — Tenders have been received from 13 firms for the electric installation of the old Llanelly Dock, viz.:—H. Coles, Swansea; R. W. Cowell & Co., London; Mather & Platt, Limited, Manchester; Bruce Peebles and Co., Edinburgh; C. E. & H. W. Peel, Swansea: R. Alger & Sons, Newport (Mon.); Electric Construction Company, Wolverhampton; National Electric Wiring Company, Swansea; Edwards & Armstrong, Bristol; and C. Howell, Limited; Clayton Engineering Company, Hyde; H. Lewis & Fletcher, Cardiff. The matter has been referred to the harbour engineer to report.

London—CITY.—The Corporation has decided to appeal to the House of Lords against the decision of the Court of Appeal that the contract with the City of London E.L. Company for the eastern district was valid.

STEPNEY.—The Borough Council has instructed Messrs. Willans and Robinson to remove the plant from the temporary to the permanent power station at their usual day rates.

Long Eaton.—A special meeting of the U.D.C. was held recently to consider a letter from the L.G.B. in regard to the recent inquiry held by Colonel Coke, on the Council's application to borrow £15,000 for works of electric supply. The letter urged the Council to consider whether it would not be better for them to accept the offer of the Derby and Nottingham Power Company for a supply of electric current in bulk, rather than expend so large a sum as that proposed in building a generating station to produce their own supply. The meeting was adjourned for further information.

Manchester.—Last week the Electricity Committee reported to the Council that the work is progressing so well that there is no fear of the supply of electricity from the station by May 1st. At the Polygon, Bennett Street, and Denton sub-stations the work is well in hand, and Messrs. Glover have made considerable progress with the laying of cables. Certain of the generating machinery for the first instalment of Dr. Kennedy's plant is now on its way to Manchester. Messrs. Yates & Thom, of Blackburn, were expected to begin this week the delivery of engines under their contract. Messrs. Babcock & Wilcox, of Glasgow, began last week the erection of boilers at Stuart Street, and the building wherein all these appliances are being placed will be completely roofed, partly permanently, by about 14th inst.

A L.G.B. inquiry into the application of the Corporation for sanction to borrow £477,000 for purposes of their electricity undertaking was held last week by Mr. H. H. Law, M.Inst.C.E. Mr. T. Hudson, deputy town clerk, in explaining the proposals of the Corporation, said that on May 7th, 1901, an inquiry was held by Mr. Boulnois regarding the money required to construct the Stuart Street generating station, and the amount then asked for was £310,110, which was the balance of an application made by the Corporation for £500,000.

The first part of the present application was to complete the scheme which was laid before Mr. Boulnois in 1901. This was the scheme of Dr. Kennedy for the construction of plant to give 15,000 H.P. at Stuart Street, and the amount required for the purpose was £82,000. The former inquiry only related to five sub-stations out of a total of 10, and the present inquiry dealt with the remaining five stations, as well as with certain additional matters which were found to be required. The second object of the inquiry was to deal with the new installation of plant at Stuart Street, which had been designed by Mr. Metzger to provide an additional 12,000 H.P., and the amount required for this purpose was £350,000. The third item related to the Dickinson Street station, which was a low-tension station. It was proposed there to substitute two new turbo-generator sets for four existing small belt-driven sets. The two new sets would provide 6,000 H.P., whereas the four old ones only provided 1,600 H.P. The estimated cost of the new sets was £43,861, and as the existing machinery cost £13,861, there was a balance left of £30,000, which was the sum the Corporation asked for sanction to borrow.

The fourth item was a sum of £15,000 for additional mains between Ashton Old Road and the Corporation's transformer station at Denton to meet their obligations in regard to Denton for the supply of energy and also for the purpose of working the tramways in Hyde Road, Gorton and Denton. The existing plant at Dickinson Street provided 12,000 H.P.; the plant at Bloom Street when completed would provide 14,000 H.P.; Dr. Kennedy's installation at Stuart Street would provide 15,000 H.P.; and Mr. Metzger's installation at Stuart Street would provide an additional 12,000 H.P., making a gross total of 53,000 H.P. actually in operation, sanctioned, or about to be sanctioned, to Christmas, 1901, with a small margin for reserve, representing 15,500 H.P.; the additional present demand for lighting, allowing for reserve, was equal to 7,000 H.P.; the additional demand for traction within half-a-mile of Bloom Street amounted to 3,500 H.P.; the current for Dr. Kennedy's 10 sub-stations, chiefly for tramways, absorbing three of the six engines put down in Dr. Kennedy's installation, 7,500 H.P.; four additional tram routes, taking the fourth engine, 2,500 H.P.; and additional requirements for light and power, including the General Post Office, which would absorb the fifth and sixth engines, 5,000 H.P. The requirements for 10 additional sub-stations connected with Mr. Metzger's scheme and for reserves, increased demands, and emergencies, would appropriate the whole of the 12,000 H.P. under Mr. Metzger's scheme. These figures showed the necessity for the fresh outlay and the additional installation which was proposed. Altogether there were 20 sub-stations, and the land for the majority of these had now been acquired. The Corporation asked that the loan should be for a period of 25 years as in former cases.

Dr. Bishop said that there were at the present time 170 applicants waiting to be supplied with current, and their demands represented something like 90,000 8-C.P. lamps.

Councillor W. H. Hesketh, Dr. Kennedy, Mr. Metzger, Mr. Allott, and Mr. T. de Courcy Meade (city surveyor) also gave evidence, after which the inquiry was closed. There was no opposition to the application.

Middlesbrough.—In order that they may successfully meet American and other competition in the steel and iron trade, says the *Manchester Evening Mail*, the directors of Messrs. Bolckow, Vaughan & Co. have decided to adopt electrical power at their

Cleveland steelworks, and have given the order for the work to the British Westinghouse Company, at a cost of nearly £70,000. A commencement has already been made with the laying down of the plant, which will be, upon completion, the most extensive electrical installation in any great works in the North of England. The electrical station is to be erected about a mile from the works. The overhead cranes will be turned into the electrical three-motor type, whilst the jib cranes will be fitted with one motor. The machinery at the railbank shops is also to be converted, and, as far as possible, each machine will have its own motor. It has also been decided to erect two new blast furnaces on the American system, and it is stated that it is the intention of the company to proceed with the erection of five new furnaces at a cost of nearly £500,000, which, on completion, will replace no fewer than 18 of the furnaces now working.

Newark.—Negotiations have taken place between the E.L. Committee and the Notts and Derby Electric Power Company, as to the supply of electricity to the borough. The company stipulated for a maximum charge of 4d. per unit for both light and power, and agreed to give the Corporation the option of purchase by agreement or arbitration. The Committee could not accept 4d. as the maximum price for power, and suggested that the company should name a more favourable charge. Also the agreement should provide that the Corporation should have the option of purchasing the works and plants required for the supply of the borough at any time after the expiration of 10 years; that the company should take over the prov. order of the Corporation, and should repay the costs incurred. The Council resolved that the company be asked to name the terms on which they suggest the purchase of the plant by the Corporation, and the date by which the company would undertake to supply electricity in the borough. The company having given notice to introduce a Bill amending their Act of 1901, a petition is to be presented by the Corporation against the Bill for the insertion of clauses protecting the rights of the Corporation.

New York.—Some new stores now under construction at Broadway and Thirty-fifth Street are to be installed with the largest private electric lighting plant in New York City. The plant will have a capacity of 2,000 KW., almost entirely for lighting purposes, as but a very small portion of it will be called into requisition for operating the ventilating apparatus, pneumatic cash carrier system, and some small pumping equipments. The elevators to be installed in the building will be worked by hydraulic power. We read in the *Electrical World* that the generators, consisting of four direct-current 110-volt direct-connected machines of 400 KW. each, and two equipments of a similar description, having a capacity of 200 KW. each, have been ordered from the Western Electric Company of New York City. The contract for the engines intended to drive the larger generators calls for Rice-Sargent machines, four compound Corliss type slow-speed, 100 revolutions per minute, having a nominal capacity of 600 H.P. each. They will be built at the Providence Engineering works. The engines for operating the two 200-KW. generators will also be of Corliss type single-valve of 320 H.P. each. These, however, have not yet been contracted for, nor have the 1,500 arc lamps and 6,000 incandescent lamps of 16-C.P. each, which will be required. The boiler equipment is to be 2,600 H.P., comprising four batteries of 500 H.P. each, and two batteries of 300 H.P. each, by Babcock & Wilcox. A crematory, which is to be utilised for burning all the refuse, &c., in the new store, is to be built between two batteries of the larger boilers, so that the gas it burns while in operation can be used to advantage by way of aiding the boiler heat. The electric plant—which it is expected will be completely installed by August 1st—will represent an expenditure of nearly $300,000.

Ormskirk.—The U.D.C. has received the report of a committee which visited the Southport Corporation Electricity works. The question as to whether the Southport Corporation were disposed to supply electricity in bulk was favourably answered, and it was decided to send a request to the Corporation asking them when, and upon what terms, they would be prepared to supply electricity to the town.

The Rand.—According to the *Diamond Fields Advertiser*, at the last sitting of the Witwatersrand Water Supply Commission, Mr. R. L. Cousins, representing Messrs. Reunert & Lenz, gave details of a scheme in which his firm was interested for the introduction of water from the Vaal River, the whole of the electrical power required for pumping being supplied by means of a series of turbines placed at Engelsbrecht Drift, some miles above Vereeniging. By this means he estimated that any quantity of water, varying from 10 to 30 millions of gallons per day, could be landed on the Rand at a cost of 1s. per 1,000 gallons. Assuming that the smaller quantity was sold at 2s. per 1,000 gallons, it would yield a return of 15 per cent. on the probable capital outlay of about a million. Moreover, the scheme would enable large tracts of land on both sides of the Vaal River to be profitably irrigated. Witness dwelt at length on the merits of a soft water for industrial and domestic purposes, and quoted authorities with the object of showing that, on account of its hardness, dolomite water was altogether unsuitable for boiler and amalgamation purposes. Mr. Bennett, the engineer and manager of the Cape Town Waterworks, said he had carefully examined the scheme, although he had not visited the site of the proposed works, and he strongly endorsed the lines on which it was proposed to proceed with the undertaking.

Swansea.—The Committee has instructed Mr. Prusmann, borough electrical engineer, to obtain tenders for two 600-KW. steam generators, the engines having a total horse-power of 2,000, not 1,500, as stated in our last issue.

Warsaw.—An electricity works is in course of erection at Warsaw, and there will be a considerable demand for electrical fittings and appliances there in the immediate future.

West Bromwich.—The E.L. Committee recommends that application be made to the L.G.B. for sanction to borrow £8,500 to carry out the extensions at the electricity works which the tramway demand has necessitated.

Wood Green.—Notices of objection to the Council's application to the B. of T. for a prov. order, have been posted by the Great Eastern and Great Northern Railway Companies for the purpose of obtaining clauses for the protection of their interests. The North Metropolitan Electrical Power Distribution Company is making application to supply electricity to private consumers, and is opposing the Council's application for an order.

Wynberg (S. Africa).—According to the *Wynberg Times*, considerable progress is being made by the Cape Peninsula Lighting Company, which since 1900 has been working concessions obtained in 1892 by Messrs. Edlin & Stevenson, of Rondebosch, for lighting that town, Wynberg, Claremont, and later Mowbray. A new power station is to be erected in Claremont, the power being transmitted on the three-phase high-pressure system to a sub-station in Wynberg, and as direct current to the other townships. At present the cost of coal alone is no less than 7d. per unit. All the plant, but the battery, is of British manufacture; the new generators are to be three Parsons turbine dynamos, and the switch gear of Messrs. Kelvin & White's manufacture. One machine will be of the three-phase type, the others being double-current generators. The sub-station will be equipped with motor-generators.

York.—The E.L. Committee has instructed the city electrical engineer to report on a scheme for the lighting of the city wholly or partly by electricity.

ELECTRIC TRACTION NOTES.

Aberdeen.—The Tramways Committee on 27th ult. agreed to equip the Rosemount section of the tramways with electric traction at a cost of over £12,000.

Auckland (N.Z.).—It is stated that a company has been formed for the purpose of carrying out the conversion of the existing horse tramways of the City of Auckland to electric traction, and also to construct several extensions, and the prospectus is shortly to be issued. The authorised capital is £300,000, divided into shares of £10 each, and the length of the lines and extensions will be nearly 19 miles.

Belfast.—At the half-yearly meeting of the Whitewell and Cavehill Tramway—a suburb of Belfast—on Monday, it was announced that the company would promote a Bill for the electric equipment of the line. A previous application was vetoed by the Irish Privy Council.

Birkdale.—The Electricity and Tramways Committee of the Birkdale U.D.C. have decided to press the Southport Tramways Company, Limited, and the Birkdale District Electric Supply Company, Limited, to proceed with the tramways and electric lighting with as much speed as possible. They have also decided to call the attention of the Southport Tramways Company to the inconvenience caused by the stoppage of all tram service for Birkdale. The accountant has submitted his estimate for constructing the permanent way from Aughton Road to the Crown Hotel at a cost of £9,484.

Birkenhead.—The Tramways Committee have recommended that application be made to the B. of T. for sanction to borrow £13,642, in order to double the tramway track on parts of the New Ferry route.

Blackburn.—The borough treasurer, Mr. J. H. Bailey, issued last week a statement of the working of the Corporation tramways for the nine months ended December 31st last. The main items of expenditure were as follows:—Engines, &c., £8,229; traffic expenses, &c., £11,667; permanent way, £879; general expenses, £1,766; a total of £22,541. The traffic receipts amounted to £28,639; parcels receipts, £245; rents and other sundries, £167; a total of £29,051, leaving a balance of £6,510 on the credit side, plus £116 bank interest. Against this balance, however, there is £4,808 instalment of loans repaid, and interest on capital, amounting to £6,250, leaving a net loss on the nine months of £4,432. The mileage run was 567,199, and the passengers carried, 5,468,590, the receipts working out at 12·11d. per car-mile. For the quarter ended June last the loss amounted to £886, and this led to the raising of fares. An increase in receipts has resulted, the quarterly report issued in September showing that the undertaking had paid its way and reduced the debt by £40. The new liability is accounted for in part by the sum of £2,421 incurred in respect of compensation and insurance for accidents arising out of the collision at Ewood last year. Repairs have also been unusually heavy during the past three months, and traffic receipts usually drop about £1,000 in the December quarter. The report will be presented at the next meeting of the T.C.

Bradford.—At midnight on Friday last the whole of the lines which have been leased by the Bradford Corporation to companies—the first lease running back to a time exactly 20 years ago—passed back to the Corporation. Great progress had been made with the conversion for electric traction during the last few weeks, and after all, the only inconvenience to the public occasioned by the expediting of the transfer will be that on two routes, steam cars will, for a short while, be running rather less frequently than before. The total disappearance of the private tramway companies was celebrated by a late supper to which the Chairman of the Tramways Committee invited all the members of the Council and the officials. At midnight, and for some hours afterwards, experimental runs were made on the newly-converted routes. On Saturday the Corporation were running altogether 82 electric, and 24 steam tram cars, and had a staff of 600 drivers and conductors.

Brake Tests on Electric Interurban Cars.—The *Street Railway Journal*, referring to Mr. J. S. Hamlin's tests of brakes on the Union Traction Company's line at Anderson, Ind., states that, with a bogie car of 32 tons (? short tons of 2,000 lbs.), 40 emergency stops were made from a speed of 58 miles per hour, within a distance of 503 to 522 ft. on the level. The length of braked run was measured by counting the number of poles passed, and by taping the fraction of the last pole spacing. Speed was also checked by counting the poles passed after maximum sp ed had been attained, and there was also a speed indicator of recording type. Only the leading trucks had motors, viz., two of Westinghouse 50 C, 150 H.P., and the brake pressure was slightly varied to allow for the rotatory momentum of the armatures being greater on the leading truck. In an emergency stop the brake-shoe pressure on the rear truck amounted to 75 per cent. of the weight on the wheels, while the corresponding pressure on the front truck was 90 per cent. The brake employed was the Christensen straight air type, with 10-in. brake cylinders, storage reservoir 48 in. × 16 in.; ½-in. engineer's valve, and an independent motor-driven compressure. The piston travel on the emergency stops was 5½ in., with a reservoir pressure of 85 lbs., and a pressure in the train pipe of 40 lbs. No sand was used, and no skidding of the wheels took place. An ordinary service stop was made on the same date from a speed of 58 miles per hour in 750 ft. In this case the train-pipe pressure was 20 lbs. only. The above results appear good, and evidently are attributed by Mr. Hamlin to the excellent order in which the brakes are maintained. He strongly emphasises the need of good brake rigging, and especially the importance of having no slack in the various pins or holes. Thus the brakes are quickly applied with a minimum piston movement of not more than 6 in. before all brake shoes are making hard contact. A diameter of ⅞ is considered to be the minimum for pins. The roller rod is held as closely as possible to the quadrant path by a clip fastened to the car body. This prevents the roller rod from being pulled laterally by the movement of the quadrant. Two men maintain and keep in repair and adjust the brake gear of 32 of the cars, and it is an instruction to the men that the condition of the brakes shall be such as to permit of the above working. Practically, the sole expense in materials is of carbons for the motor which drives the compressor. The small amount of care usually given to brakes and brake gear is quite a sufficient excuse for a description of the means adopted by a man who thinks that the subject is of real importance. Considering that tramcars are called upon to run down gradients so very much steeper than any that occur on main line railways, the importance of brake gear efficiency and strength is really great. There is nothing but the gear to hold a car when running down hill, and we can scarcely conceive any more ridiculous appliance than the hand brake gear of the ordinary tramcar, with its overhung chain spindle, and its weak position on an already weak dashboard. The brake, as it is found on the electric car, has survived from the horse-car brake—in fact, is a direct copy of that humble prototype. The horse-car brake may have sufficed for a small light car, but it is made to do duty on cars of 7 or 8 tons, for which it is wholly insufficient, while, at the same time, its working is beyond the physical capacity of the car driver.

Edinburgh—Glasgow Mono-Rail.— The Edinburgh correspondent of the *Financial Times* says that a scheme is being promoted for the purpose of constructing a railway upon the mono-rail system between Edinburgh and Glasgow. The plans have been prepared and the route mapped out, and these have as a preliminary been submitted to the Board of Trade. The distance between the two cities is 49 miles by the most direct route possible, and the distance will be covered in 29 minutes, or at a relative speed of 117 miles per hour. A service of six trains per hour both ways will be inaugurated. At present the two cities are connected by the North British and Caledonian system, and the service is about hourly each way, the fastest train covering the distance in 65 minutes. An immense traffic passes between the two cities.

Enfield.—The Earl of Jersey, Colonel Boughey, and Mr. Henry Allan Stewart, the Light Railway Commissioners, spent over four hours at Enfield last week holding an inquiry respecting an application by the Middlesex County Council for an order authorising the construction of a light railway from Green Lanes, Winchmore Hill to Enfield Town. The promoters urged that the scheme would be a great and essential improvement to the town, and the workmen would be enabled to have better communication with London, whereas at present the G.E.R. and the G.N.R. were unable to cope with the requirements. Already, trains passed through Bethnal Green Junction at the rate of one per minute, and to increase the present number of trains would be positively dangerous. To carry out the proposed scheme it would be necessary to bring the line along London Road, and a large block of buildings would have to be removed. The New River Company objected to the great pressure which would exist on two mains which passed up one of the roads, and a clause of protection was asked to be inserted in the Order. The Commissioners said the scheme would be a public improvement, and therefore they would recommend its adoption to the Board of Trade. The decision on the point raised by the New River Company was deferred.

Glasgow.—The First Division of the Court of Session on 29th ult. disposed of an appeal in a complaint by Thomas Simpson, coalmaster, against the Glasgow Corporation for running electric cars past his house at Pollokshields at a speed exceeding eight miles an hour, prescribed by the Board of Trade regulations. The Sheriff-Substitute found that the rate was exceeded, but that Simpson had no title to sue; but the Court last week decided that he had such title, and remitted to the sheriff to proceed in the complaint. The penalty is £10 for each offence.

Gloucester.—A special meeting of the Council will be held on March 12th for the purpose of considering the proposed purchase of the tramways, with a view to their municipalisation and conversion into a system of electric traction.

Halifax.—The Board of Trade has settled the dispute between the Halifax Corporation and Hebden Bridge District Council, having decided in favour of the Halifax authority. The Mytholmroyd-Hebden Bridge and Mytholmroyd-Fallingroyd Bridge extensions will, therefore, be proceeded with at once.

Liverpool.—The Tramways Committee calculate that for 1902 the working expenses of the electric tramways system will be £350,000. This is an increase of £12,500 upon the amount for 1901. They estimate that the income will more than suffice to meet the expenditure. The income for 1901 was £476,073; an increase of £51,062 upon that of 1900. The loans on tramways account at the beginning of 1902 totalled £1,662,773. The estimates on capital expenditure account total £122,900; this sum includes the estimated cost of extensions on the Cabbage Hall route, of £9,600; on the Old Swan route, of £20,900; on Linacre Road, of £85,000; alterations at Pier Head, £16,000; and at St. James's Place, £1,300. Construction of car sheds will require some £16,000; new cars, £6,000; and buildings and machinery, £26,500. Last year's expenditure on cars and maintenance, including salaries, was £38,355 12s. 9d.; on energy, £72,352 16s. 10d.; on renewal of lines and equipment, £19,157 9s. 10d.; road and traffic expenses, salaries and wages amounted to £108,976 14s. 7d. The balance to credit on last year's working was £147,056 18s. 3d.

London and Tilbury Railway and Electric Traction.—Speaking on Thursday of last week at the half-yearly meeting of the L.T. and S. Railway, the chairman, Mr. H. D. Browne, said they had deposited a Bill in Parliament for the purpose of taking powers to electrify their line. The probability was that the District Railway would be electrified within the next two years, and if the traffic on the new Bow and Whitechapel Railway was to be worked to the best advantage, that would have to be electrified, and the board had therefore thought it wise to ask for powers to electrify the whole of their system. It was possible to imagine that, at any rate, as far as their local traffic down to Barking was concerned, it might be both economical and advantageous to electrify the railway as far as that point. They had taken time by the forelock in depositing their Bill, but, of course, before they decided upon applying electricity to the whole of their line, they would wait to see whether there was such an improvement in motor power as to render such a course profitable. He thought there was little doubt that for tramways electricity was the best motive power, but they must wait further developments before they applied it to ordinary railways.

Manchester—Liverpool. — It is announced that the Board of Trade have now approved the revised plans for the Lightning Express between Liverpool and Manchester with the exception of a few details. The *Manchester Dispatch* says that considerable alterations were made in the plans approved by the Parliamentary Committee, to guard against any possible dangers of electrification.

Newcastle-on-Tyne.—The Corporation have put down t amlines in front of St. John's Church only 3 ft. 6 in. from the kerbstone, which would have had the effect of preventing any carriages from stopping outside the church door. The matter had been brought to the notice of the Board of Trade, and to that authority the Corporation had written admitting they had laid the lines without having any Parliamentary sanction for the double line. They, however, undertook, after obtaining the necessary powers, to work a single line only when a cab or a carriage was standing in front of the church door.

Norwich.—A veterinary surgeon named Ruffee claimed damages for personal injuries alleged to have been caused through negligence of the Norwich Electric Tramway Company, one of whose cars upset his horse and trap and injured him seriously. A jury at the Norwich Assizes awarded him £104 for personal injuries, and £750 damages.

South Shields and Sunderland.—The Durham County Council have decided to petition Parliament against the passing of the South Shields and Sunderland Tramways Bill unless the promoters carried out certain suggestions of the county surveyor. It is feared by some that the alterations would be so costly that very possibly the promoters would be prevented from carrying out the scheme. The point involved is that the road is in some

places only from 17 to 20 ft. wide, and the surveyor suggested that it should be made at least 24 ft. all along, and that the work should be done at the expense of the promoters.

Sutton.—The U.D.C. has consented to the promotion of he tramways Bill of the British Electric Traction Company.

Underground Railways.—The scheme for a "tube" ine from a point near Cannon Street Station to Southwark, Vauxhall, Wandsworth and Wimbledon has been abandoned.

Wolverhampton Tramways.—On Wednesday the town clerk received an intimation from the Railway Department of the Board of Trade that the Board are prepared to grant a license for 12 months for the working of the lines on the Lorain surface contact system. At the same time the town clerk was referred to "Section 41 (4) (*b*) of the Wolverhampton Corporation Act, 1899, which provides that, if the Board are of opinion that the mechanical power authorised under the Act is a danger to the passengers or the public, they may direct that its use shall cease, or be continued only subject to conditions to be imposed." The reports of Colonel Yorke and Mr. A. P. Trotter, who inspected the experimental line, were also enclosed.

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	.. June 20, 1899 ..	..
Para-Maranham	.. March 1, 1900 ..	..
Mole St. Nicholas-Port au Prince	.. Dec. 28, 1901 ..	..
Havre-Waterville	.. Jan. 27, 1902 ..	..
Shanghai-Hong Kong	.. Jan. 24, 1902 ..	Jan. 29.
Alexandria-Laruaca	.. Jan. 19, 1903 ..	..
Trinidad-Demerara	.. Jan. 30, 1902 ..	..
Landlines :—		
"*Via* Hanekin" on Persian territory	Feb. 24, 1900 ..	..
Communication with Baranquilla and Cartagena	Dec. 8, 1900 ..	..

The Telephone Agreement.—In the House of Commons on January 31st, in reply to several members, Mr. Austen Chamberlain spoke as follows (*Times* report):—"The agreement of November 18th last makes no addition to the cases in which terminal fees are payable on trunk wire conversations between the subscribers of the Post Office, of the National Telephone Company, and of licensed corporations. Before that agreement was concluded, the company had the right to charge terminal fees in all cases on conversations with their subscribers originated by subscribers of other systems. The Post Office and licensed corporations had the right to charge similar fees on conversations originated by the company's subscribers. The agreement of November 18th provided that no terminal fees were to be charged on any conversations in which London subscribers, either of the Post Office or of the company, were concerned. This condition does not apply to any conversations between places outside the London area. Terminal fees are still payable on all conversations between provincial subscribers of the Post Office and the company, as well as between subscribers of licensed corporations and the subscribers of the company in all parts of the United Kingdom. No terminal fees are now, or have ever been, payable on conversations between subscribers of the Post Office and subscribers of licensed corporations. The concession made by the company to the Post Office and by the Post Office to the company is a mutual concession, having exactly the same effect on each side. The Post Office never has charged, and will not charge, any terminals on conversations originated by subscribers to the systems of licensed corporations in the provinces and their own subscribers in London. The general effect of this clause in the agreement is to leave the position of licensed corporations exactly what it was before the agreement was signed, but to give a slight advantage to subscribers to the London Post Office system over subscribers to the National Telephone Company's system in London. The National Telephone Company state that they have about 40,000 subscribers to their system in the London Telephone area, with any one of whom a Post Office subscriber will be able to communicate.

Wireless Telephony in France. — French journals report that some experiments of the greatest scientific interest took place on January 16th, 17th and 18th, at the Château de Marchais in the presence of H.R.H. the Prince of Monaco.

Prince Albert, who is particularly interested in wireless telegraphy—as he showed during the experiments made by the Marconi Company between Biot and Caloi—had placed his domain at the disposal of M. Louis Maiche, civil engineer, for his demonstration of the transmission of electrical waves through the earth without wire. The inventor, who is well known for his extensive researches in the domain of telegraphy and telephony, made experiments in the transmission of words and signals on the Morse code by earth currents.

This is briefly the result of the tests with an improvised apparatus and a current of ·003 ampere and 8 volts.

1. At 1,500 metres conversation transmitted as distinctly as by the best ordinary telephone system.

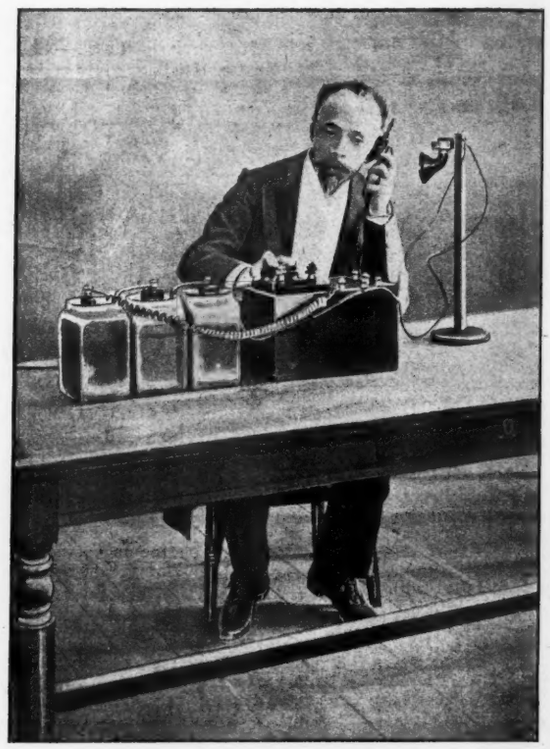
2. At 4 km. speech still very distinct, but seeming to have arrived at the limit of perceptible intensity.

3. At 7 km. vibrations of the telephone plate sufficiently distinct to allow of Morse signals being transmitted with the utmost regularity.

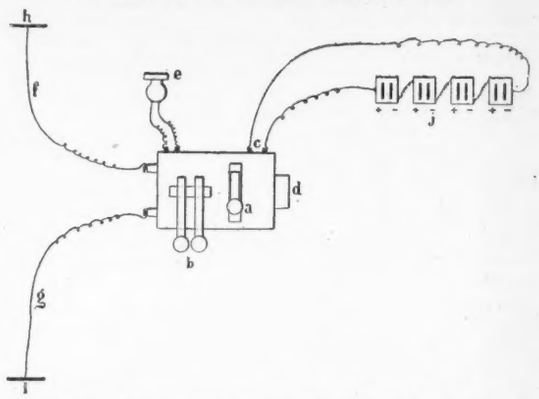
The experiments could not be carried further as this would have taken them beyond the limits of the domain of Marchais. The transmitting apparatus used by M. Maiche consists, besides the source of electricity, of an improved microphone and an induction coil wound in a special manner. In the case of the transmission of Morse signals, a key and vibrator are substituted for the microphone.

In both cases the receiver was a sensitive telephone.

The connections to earth consisted sometimes of two electrodes immersed in water, and sometimes of electrodes embedded in damp earth. The two electrodes at each station were connected by an insulated wire which formed a basis on which was connected, according as required, the receiver or the transmitter.



M. Maiche Telephoning Without Wires.



a, Manipulator; *b*, Key; *c*, Battery terminals; *d*, Diffuser; *e*, Telephone *f*, *g*, Earth wires; *h*, *i*, Earth plates; *j*, Battery.

As, according to M. Maiche, long-distance experiments alone could show (as if the Bourbouge experiments had not already settled this question decisively !) what length of base should correspond to augmentations in the current conveyed, H.R.H. the Prince of Monaco has kindly placed at M. Maiche's disposal his yacht *Princess Alice*, and the local resources of the principality for long-distance experiments which will shortly be made in the Mediterranean, and between the French and Italian shores. Evidently, as augmentations of current are mentioned, Morse signals will be transmitted, for which the telephone will act as receiver.

No doubt it would be advantageous to add, and this has not as yet been done, a coherer and a battery to the telephone. The coherer would act as a very sensitive kind of relay.

According to the French journals above-mentioned, we may expect marvellous discoveries and results from M. Maiche, who could not be under better patronage than that of the Prince of Monaco.

(*Continued on page* 227.)

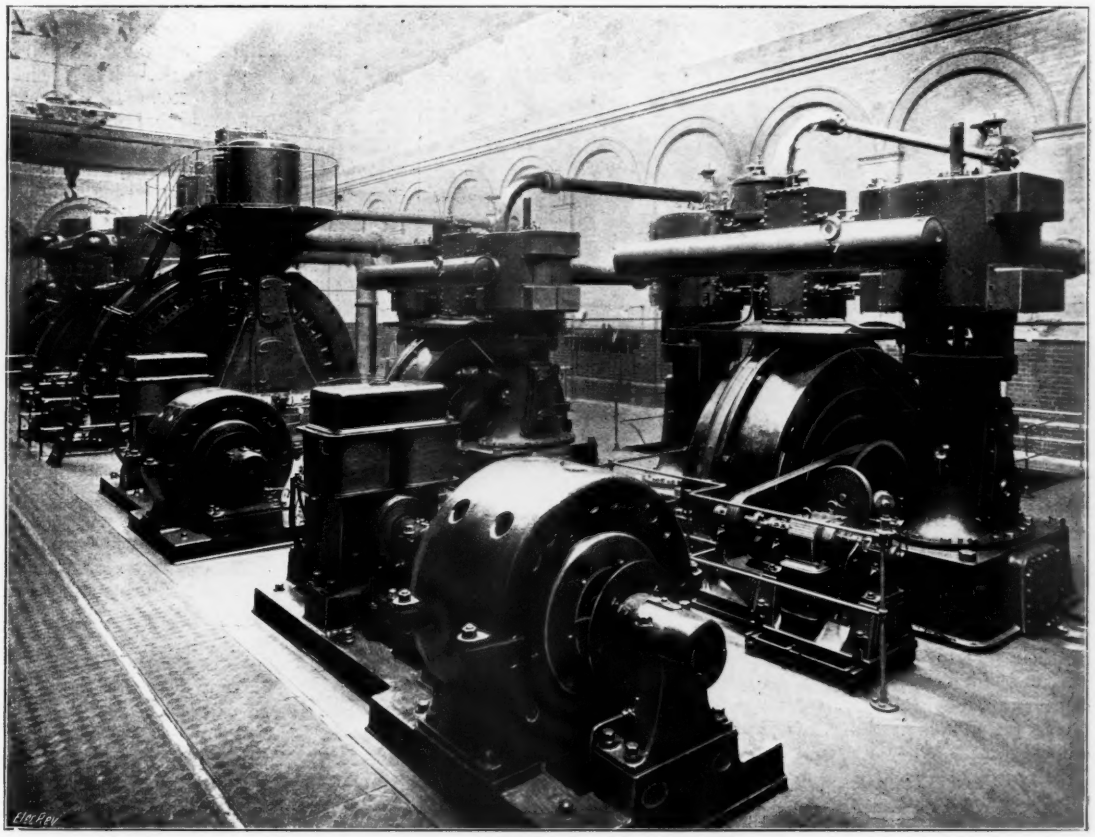
SOUTH LONDON ELECTRICITY WORKS.

The South London Electric Supply Corporation, Limited, was formed at the end of 1896, to establish a system of electricity supply in the parish of Lambeth; for this purpose the provisional order which was granted to the Vestry in 1892 was transferred to the company, the Vestry retaining powers to purchase the undertaking at the end of 21 years, at a premium of 25 per cent. above its value determined according to the Electric Lighting Acts, or, at the end of 31 years, at par. The company also agreed to destroy the refuse of the parish for a payment of 11½d. per ton, and to supply energy for 25 arc lamps free of cost. Messrs. Kincaid, Waller & Manville were appointed consulting engineers; the high pressure single-phase alternating current system was adopted, and the contracts were placed with Messrs. S. Z. de Ferranti, Limited, for generating plant; Messrs. Manlove, Alliot & Co., Limited, for buildings and destructor plant, and the British Insulated Wire Company, Limited, for the mains.

The site selected for the generating station was a piece of vacant ground by Loughborough Junction, near the middle of the area to be dealt with. The latter is of a peculiarly difficult character, being 6 miles long in its greatest dimension, north and south, and less than 2 miles wide at most; at one point the width narrows to ¼ mile! Further, the southern half of the area is of a spotty description, rendering it by no means easy to devise an economical and effective system of supply. The northern portion of the area, however, is of a more favourable character, embracing North and South Lambeth, Kennington, and the greater part of Brixton, all densely-populated and busy districts.

The generating station is built of brick, and consists of an engine room, 137 ft. × 48 ft. × 45 ft. high; a boiler and destructor house, 121 ft. × 90 ft. × 50 ft. high; battery and testing rooms, and pump room. Adjoining are the coal bunkers and stores, the company's offices, water-softening plant, and a cooling tower.

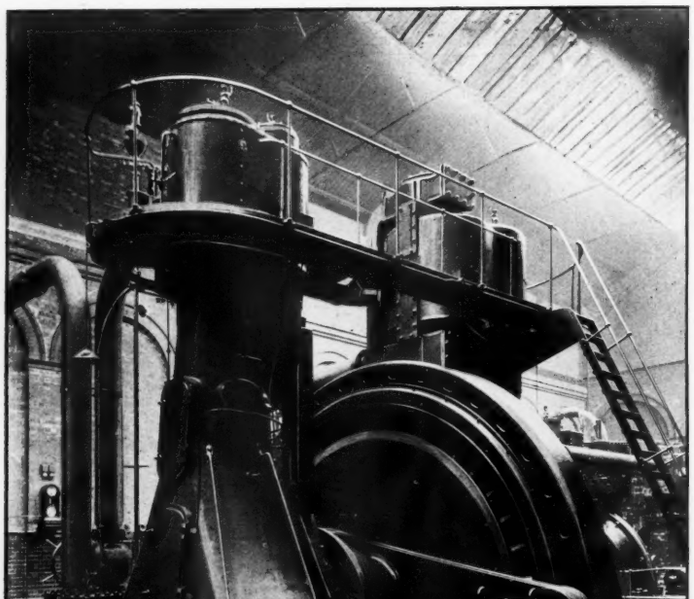
The coal stores are capable of accommodating about 1,000 tons of coal. A complete equipment of mechanical conveyors is provided for handling the coal, consisting of a belt conveyor to carry the coal from the stores to a hopper outside the boiler house, a bucket elevator, and a worm conveyor to carry it along the building over the boilers. Trap-doors in the conveyor trough permit the coal to fall as required through shoots, which are provided with branched funnels over the hoppers of the mechanical stokers. All the conveyors are driven by direct-current Lundell motors, with double-wound armatures, which can be run in series or in parallel at 100 volts, to give two speeds without loss of efficiency. These drive worm gear through spur wheels and pinions, giving a double reduction of speed.



General View of Engine Room.

There are eight boilers, of the Babcock & Wilcox double-drum type, each capable of evaporating 10,000 lbs. of water per hour. These were originally fitted with Vicars mechanical coking stokers for burning small coal, but

owing to incessant difficulties with the authorities on the score of smoke nuisance, large Welsh coal has been adopted, which, of course, has to be fired by hand. It is satisfactory to add that, under proper management, this expedient has put an end to the trouble without adding to the cost of fuel. Two of the boilers are still fitted with the mechanical stokers.



B.T.H.-Yates & Thom 500-kw. Generating Set.

On their way to the chimney, which is octagonal in shape, 180 ft. high and 11 ft. in diameter inside, the waste gases pass through one or both of two Green economisers, each consisting of 288 tubes. The scrapers are driven by Langdon-Davies single-phase induction motors of 2 h.p. each. Bye-pass flues and cross-over dampers are provided for use when necessary.

The destructor plant consists of 16 Manlove & Alliot cells, arranged one on each side of a boiler. These are fitted with the Boulnois & Brodie patent charging trucks, which are filled by means of elevators, and travel over the top of the cells, distributing their contents as required; these arrangements are very similar to the plant installed at the Shoreditch electricity works. Forced draught is supplied by means of four fans driven by 20-h.p. electric motors, and feeding into an air duct at the back of the boilers. Owing to litigation which is in progress, the destructor plant is at present disused.

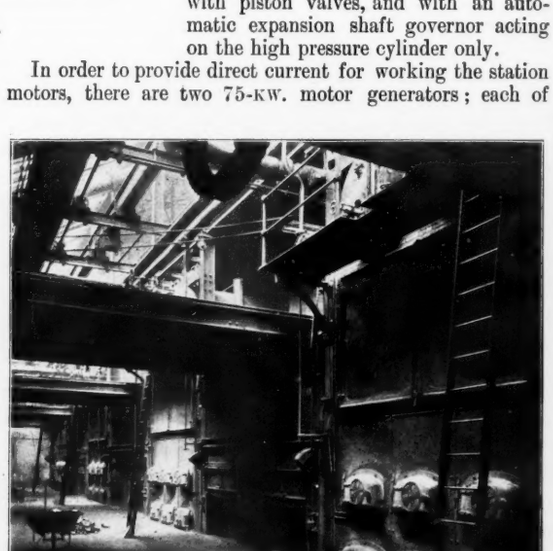
Feed water is supplied by four Hayward Tyler three-throw pumps, three of which are driven by steam engines, and one by a Lundell motor with double-wound armature. Two of these are capable of supplying 5,000 gallons each per hour; the other two, one of which is the electric pump, are of half this capacity. The feed piping is in duplicate throughout, with a bye-pass to the economisers. The water supply may be obtained from the town mains, but the main supply is got from an artesian well, which was sunk by Messrs. Isler and Co. The water is pumped from the latter by means of a Blake-Knowles compressed-air pump, driven by a Greenwood & Batley motor.

An extensive water-softening plant has been installed, and is nearly completed.

The steam range was supplied by Messrs. Babcock and Wilcox, and consists of a ring main with a cross connection in the centre; it is divided into sections by means of stop-valves. The pipes are of lap-welded steel, expanded into flanges, which are also riveted to the pipes. The joints are of the spigot and socket type, and the whole forms a high-class piece of work. The boilers work normally at 200 lbs. per sq. in., and superheated steam is always used.

The generating plant consists of five direct-coupled sets, working at 3,000 volts, 50 cycles per second. Four of these consist of Ferranti vertical cross-compound engines driving Ferranti alternators of the "copper" type, mounted on the shaft between the cranks. One set, which we illustrate, is of 1,000-kw. output, and runs at 160 revolutions per minute; another is of 1,200 kw., running at 250 revolutions per minute. The remaining two are of 300 kw. each, and run at 250 revolutions per minute. All four engines are of the latest pattern, with Ferranti's patent valve gear and throttle governors. The expansion ratio in both cylinders can be varied by hand. Each set drives its own exciter by ropes, the exciters being of Messrs. Thos. Parker's manufacture. The fifth set, shown in the adjoining figure, consists of a British Thomson-Houston fly-wheel alternator, with iron-cored stationary armature, driven by a vertical cross-compound engine, built by Messrs. Yates & Thom, of Blackburn; this alternator is of 500 kw. output, and runs at 160 r.p.m. The engine is fitted with piston valves, and with an automatic expansion shaft governor acting on the high pressure cylinder only.

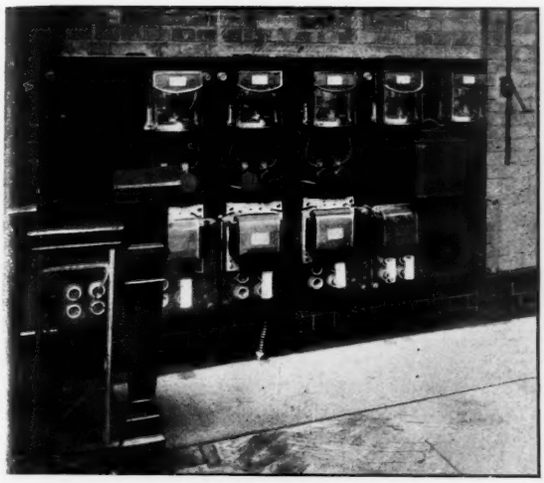
In order to provide direct current for working the station motors, there are two 75-kw. motor generators; each of these consists of a Ferranti synchronous A.C. motor of the iron-core type, operated direct from the bus bars at 3,000



Boilers and Destructor Cells.

volts, and coupled to a Crompton two-pole dynamo, giving 75 KW. at 100—130 volts.

A complete condensing plant has been installed in the



Watt-hour Meter Board.

main subway under the engine room, capable of condensing 28,000 lbs. of steam per hour. The plant was supplied by Messrs. Cole, Marchent & Morley, who also installed the piping. The condenser is of the tubular surface type; the air and circulating pumps are driven by a vertical compound engine. The circulating pump is of the double-acting piston type, and the air pump is of the Edwards type, both being coupled to the same shaft. A Zschocke cooling tower, supplied under sub-contract by Messrs. Doherty & Donat, Manchester, has been erected in connection with the condensing plant; the tower, of which we give a view, is 85 ft. high, and is built of creosoted wood. The hot water enters the tower at about half its height, and falls through grids, which break it up into drops. Natural draught is used, but forced draught can be applied if necessary. The exhaust steam is passed through a Bundy oil extractor before reaching the condenser, and the hot-well water is passed through a Rankine filter. Provision has been made for extending the condensing plant at any time, the piping being specially designed with that purpose in view.

Alternatively, a main atmospheric exhaust pipe is led from the engine room to the chimney, where it is divided into three pipes, which are taken to the top of the shaft.

The switchgear for the high pressure system is mounted on a gallery at one end of the engine room; it is all of the Ferranti standard single-pole type, and is shown in our illustrations. The generator switchboard consists of 10 panels, of which eight are machine panels, and two are inter-connector panels. By means of the latter, the plant can be run in two groups, or the whole can be run in parallel. Notwithstanding the difference in wave form and other characteristics of the Ferranti and B.T.H. alternators, not the slightest difficulty is experienced in paralleling or in running the sets in any desired combination. The main generator switches, working at 3,000 volts with a single break, are of the oil-break type; an oil chamber is fixed at the back of the switch compartment, containing a fixed contact and an iron plunger connected with the switch mechanism. The break takes place first on the main contacts, which are of the usual type, whereby the current is diverted through the plunger; as the motion of the switch arm continues, the plunger is released, and is forcibly separated from the fixed contact by a spring, which causes the final break to take place quickly beneath the surface of the oil. This type of switch is found to operate with entire satisfaction under all conditions of practice.

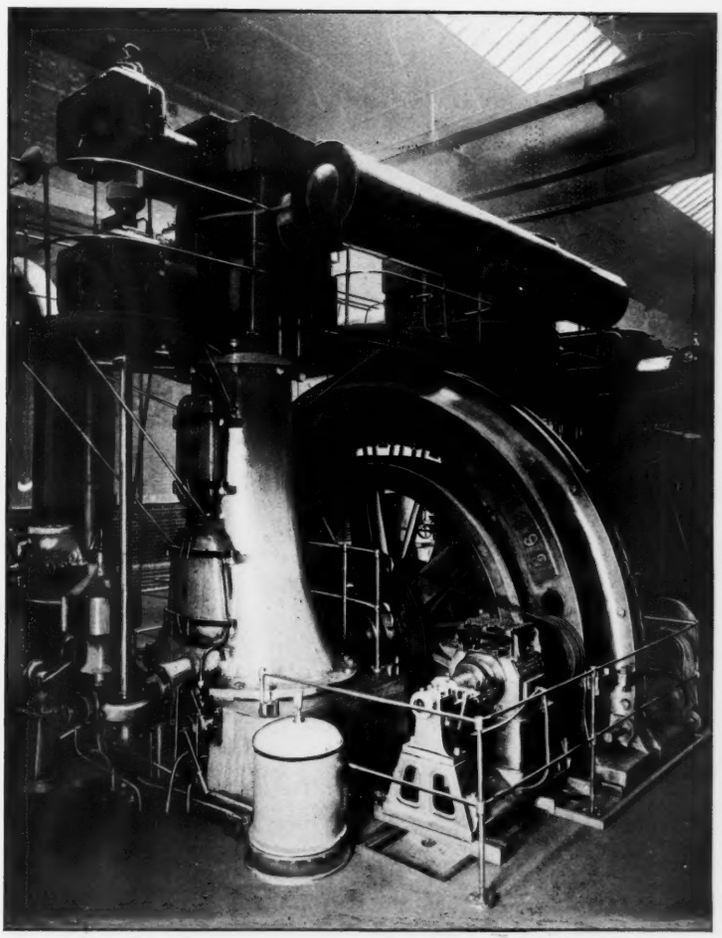
The usual synchronising gear is provided on the generator board, with Ferranti edgewise ammeters for the alternating current and Nalder ammeters for the exciting current.

There are two feeder boards, placed at some distance on either side of the generator board—a convenient arrangement, which permits of extensions being made without the least difficulty.

The feeder boards are of the usual type, standard throughout, and consist of eight panels each.

There are also two meter boards, one at each end of the switchboard gallery, fitted with Thomson watt-hour meters and transformers, for the feeder and motor-generator circuits, and a recording voltmeter is provided in connection with the bus bars.

A large indicator is fixed on the wall near the generator board, and serves to convey visual instructions to the drivers; it is visible from all the engine stop-valves. The indicator consists of ground-glass plates bearing the numbers of the sets, and such words as "slower," "steady," &c., the particular order being singled out by means of a lamp placed behind it; the various lamps are controlled by a key-board at the generator switchboard, and attention is called by means of a large bell.

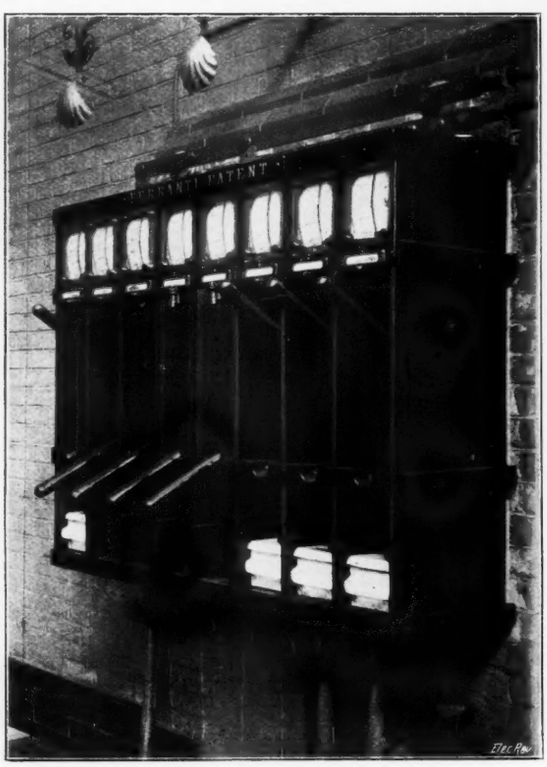


Ferranti 1,000 KW. Steam Alternator.

The storage battery consists of 55 cells by Messrs. Pritchetts & Gold, of 3,000 ampere-hours' rated capacity. A special switchboard is provided near the battery room, made by Messrs. Nalder Bros., and consisting of five panels,

for controlling the battery charge and discharge, and the various station circuits. In case of emergency, the battery can also be used for exciting the alternator fields.

COOLING TOWER

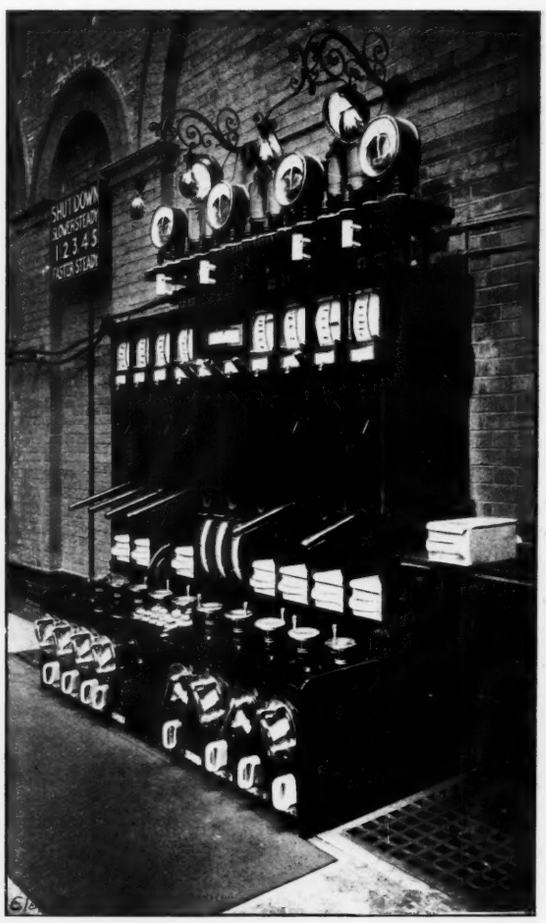


FEEDER BOARD.

A single-motor electric crane of 15 tons load, built by Messrs. Higginbottom & Mannock, spans the engine room, and is one of the machines operated by the battery.

The system of mains consists simply of six feeders supplying independent networks. As already mentioned, the demand is so distributed, that it is not worth while to adopt any inter-connected system. Each of these high-pressure networks feeds a number of transformers in street boxes, and each of these again supplies a small local and independent low pressure network. The high-pressure feeders are all drawn into Doulton earthenware ducts, in which an ample number of spare ways has been provided. The low pressure mains are laid in bitumen on the solid system. All the cables were supplied by the British Insulated Wire Company, Limited, and are of their standard paper-insulated lead-covered type.

The transformers were almost all made by Messrs. Ferranti, and are of their standard type, as are also the street boxes, &c. Some Berry transformers are also in use, and a few of other makes. The majority are of 30 KW. output.



MAIN SWITCHBOARD.

The consumers are over 1,000 in number, although the station has only been at work for two years. This is, however, partly explained by the fact that supply was commenced some time before the station was ready, energy being purchased in bulk from a neighbouring company. The lamp connection is equivalent to 58,000 8-C.P. lamps, and there are a few motors in use. It is difficult to understand why single-phase motors are not far more widely adopted in British towns, for, though admittedly inferior in some respects to polyphase or direct current motors, they are beyond doubt perfectly reliable and practical machines, and could readily be applied to innumerable purposes with certainty of success.

The general supply is given on the two-wire system at 220 volts; energy for lighting is charged for at the flat rate of 5¼d. per unit, and for power at 2d. per unit. The meters used are of the British Westinghouse type.

The 25 arc lamps which the company feeds for the Borough Council, are of the Brockie-Pell type, and recently the

Jevons time switch has been adopted for switching them in and out at the proper hours, requiring only weekly attention.

We may add that the temporary direct current power station of the L.C.C. tramways is to be built at one end of the existing station of the South London Corporation, by whom it will be operated.

The engineer-in-chief is Mr. H. W. Sprunt, to whom we are indebted for kind assistance in the preparation of this article, and for facilities to photograph the plant. Mr. Sprunt is assisted by Mr. G. R. J. Parkinson, station superintendent, and Mr. T. E. Pickford, superintendent of mains.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 222.)

Dundee Telephones.—The town clerk issued 6,470 circulars to probable subscribers for a municipal service, but only 440 replies were received approving of the scheme. A special canvasser is to be employed to get into touch with those who did not answer.

Portsmouth Telephones.—It is stated that the Telephone Committee hope to accept tenders shortly, the specifications having been revised owing to a considerable fall in the price of metal, and two sections are to be carried out by the committee's own staff, to give them practical experience.

St. Petersburg Telephones.—The telephone exchange of the Bell Telephone Company, of St. Petersburg, has been acquired and taken over by the municipal authorities of that city. An important reduction in the annual charge is one of the first results.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—February 12th. Tramway poles, bases and trimmings for Corporation. See "Official Notices" January 24th.

Aberdeen.—February 15th. Overhead equipment, poles and bonding; also cables for three tramway routes. See "Official Notices" January 31st.

Battersea.—February 18th. Coal, carbons, meters and stores, for the electricity department. See "Official Notices" to-day.

Belgium.—February 15th. Proposals are being invited by the municipal authorities of Lourain for the lighting of the public streets by electricity or gas.

Belgium.—March 1st. The municipal authorities of Ghent are inviting tenders until the March 1st, 1902, for the concession for an electric lighting installation. See our "Official Notices" January 3rd.

Birkenhead.—The Tramways Committee ask for tenders for supplying and fixing machinery for the repairing shop at the Laird Street Depôt. Forms and particulars from Mr. A. R. Fearnley, tramways manager, Sessions House, Birkenhead.

Birkenhead.—February 11th. Feeder mains, pilot wires, and distributing mains for Rock Ferry and district for the Corporation. See "Official Notices" January 24th.

Birkenhead.—February 24th. Lancashire boiler and stokers for the Corporation electricity works. See "Official Notices" to-day.

Bournemouth.—February 12th. Steel poles, overhead lines, section boxes, arc lamps, poles and carriers, for the T.C. See "Official Notices" January 31st.

Bournemouth.—February 21st. Motor-generator for Corporation tramways. See "Official Notices" to-day.

Brighton.—February 10th. Ten tramcar bodies, trucks, and electrical equipments for the Corporation. See "Official Notices" January 31st.

Christiania.—February 19th. H.M. Consul-General at Christiania reports that tenders are invited for 3,000 metres 1·5 millim. india-rubber insulated copper wire; 4,000 metres seven-strand india-rubber insulated copper cable; 100 kilog. tinned plain copper wire; 150 kilog. three-strand plain copper wire.—Telegraph Inspector's Office, No. 8, Stenersgade, Christiania.

Croydon.—February 17th. 10 double-deck double-truck cars with motors, &c., for Corporation. See "Official Notices" January 24th.

Dulverton.—The E.L. Committee invites proposals for lighting the town. See "Official Notices" January 31st.

East Ham.—February 22nd. One 500-KW. c.c. generator with 800-I.H.P. engine; water-tube boilers, condensers, &c., for the U.D.C. See "Official Notices" to-day.

Edinburgh.—March 3rd. Electric lighting installation for the third portion of the Colinton Mains Fever Hospital (600 points) for the Council. See "Official Notices" to-day.

Fulham.—February 26th. Two 50-KW. steam dynamos and boosters, four dryback marine boilers, battery, and wiring for 2,000 lights, for the Guardians. See "Official Notices" January 31st.

Glamorgan.—The County Council is now inviting tenders for the erection of an electric plant house at Bridgend Asylum. Particulars of W. E. R. Allen, County Council Offices, Cardiff.

Glasgow.—February 21st. Switchboard extensions for the Corporation. See "Official Notices" January 31st.

Hammersmith.—February 12th. Electrical stores and Welsh coal, 12 months' supply for the Council. See "Official Notices" January 31st.

Islington.—February 26th. Tubular well and pumping gear, at the electricity works. See "Official Notices" to-day.

King's Lynn.—February 21st. A Lancashire boiler and piping for the electricity works. See "Official Notices" to-day.

Leeds.—Concentric (high tension), two-phase (low tension), and L.T. triple-concentric paper cables for the electric lighting department. See "Official Notices" January 31st.

Leyton.—February 13th. Steam and other piping for U.D.C. electricity works. See "Official Notices" January 24th.

London.—February 12th. In a list of details required by the London School Board for twelve months we observe "electrical necessaries" for the *Shaftesbury*. Forms of tender, &c., at the offices, Victoria Embankment.

London.—March 4th. The L.C.C. is wanting tenders for 100 or 50 double-deck double-bogie tramcars for conduit lines in South London. Drawings, &c., at the County Hall, Spring Gardens, S.W. (£3).

Manchester.—February 13th. Condensing plant, cooling towers and feed water heaters for the Corporation. See "Official Notices" January 24th.

Manchester.—February 19th. Electric travelling crane for generating station, and hand travelling cranes for sub-stations. See "Official Notices" to-day.

Newcastle.—February 12th. The Corporation wants tenders for laying 1½ miles of single line tramway, &c. Specifications from the City Treasurer (£3 3s.).

Oban.—The Town Council wants tenders for wiring consumers' premises on the "easy" system. Apply to Mr. Alex. Black, Town Clerk.

Pemberton.—February 19th. Balancing and boosting set for the U.D.C. See "Official Notices" to-day.

Rochdale.—February 25th. Traction switchboard and accessories, for the Corporation. See "Official Notices" to-day.

Rockhampton (Australia).—March 31st. The Council of the Municipality of Rockhampton is prepared to consider applications from companies desirous of undertaking the construction and working of a system of electric tramways under the Queensland Tramways Act of 1882, and the Amendment Act of 1890. See ELECTRICAL REVIEW, January 10th.

Roumania.—Tenders are being invited by the municipal authorities of Bacau for the concession for the electric lighting of the town. Tenders are to be sent to La Mairie de Bacau, Roumania, whence particulars may be obtained.

Salford.—February 8th. Two 150-KW. continuous current motors for the electricity works. See "Official Notices" January 24th.

Shipley.—The D.C. is inviting tenders for the construction and reconstruction of about 1½ miles of double line.

Shipley.—February 10th. Traction switchboard, boosters and balancers, switchboard alterations, for the Council. See "Official Notices" January 24th.

West Ham.—February 11th. Engine room stores, cable, boxes, transformers, lamps, electrical instruments, &c., for the Council. See "Official Notices" January 31st.

CLOSED.

Bilston.—With reference to the note in our last issue on page 183, where it is stated that the British Westinghouse Company secured the contract at £5,850, and that the lowest tender was that of the Lahmeyer Electrical Company, at £3,565, the latter company point out to us that their tender was for £8,565, and consequently was not the lowest, but nearer the average price.

The following letter on the same subject has come to hand from The Electric Construction Company, Limited:—"In your issue of last week, it was announced under the heading of 'Contracts Closed,' that according to the *Contract Journal*, the order of the Midland Electric Corporation for power distribution plant had been placed with the British Westinghouse Company, at £5,850; that the lowest tender was that of the Lahmeyer Electrical Company, £3,565, and the highest, that of the Electric Construction Company, at £10,070. We beg to point out that a comparison between the successful tender and our own is quite misleading, being based upon different specifications."

Cardiff.—At a meeting of the Tramways Committee on Friday last week tenders for two engines were considered. According to the local press, the tenders sent in were:—

Ferranti, Limited	£9,381
Robey & Co.	11,260
Markham & Co.	11,330
Yates & Thom	11,412
D. Stewart & Co.	11,500
Combe, Barbour & Co.	11,840
Victor, Coates & Co.	12,700
Bevor, Darling & Co.	12,837
J. Musgrave & Son (*accepted*)	14,074
Cole, Marchent & Morley	14,126
Hick, Hargreaves & Co.	15,100
Davey, Paxman & Co.	15,308
Ashton, Frost & Co.	15,470

After a long discussion the committee decided to accept the tender of Messrs. Musgrave & Son. The examination of the tenders was all the more severe in consequence of a statement made by the agent of one of the companies tendering to the effect that the result of the tendering was a foregone conclusion. Two firms were struck out because their tenders were not to specification, three because they could not deliver in time, and one because no particulars were sent. The engines to be supplied under the accepted tender will weigh 225 tons, with a fly-wheel of 70 tons; the standard of efficiency is 92 per cent., and the steam consumption per I.H.P. showed the lowest average.

The engineer, Mr. Arthur Ellis, presented details of the tenders received for supplying two continuous current generators of not less than 900 KW. The tenders were divided into classes, English and foreign, and were as follow:—

	Generators only.	Generators with spares.
ENGLISH—		
Electric Construction Company	£7,186	£7,305
Crompton & Co.	6,704	6,890
Mather & Platt	6,050	6,208
Bruce Peebles & Co.	5,400	5,990
Siemens Bros. & Co.	5,660	5,760
Dick, Kerr & Co. (*accepted*)	5,500	5,560
AMERICAN—		
British Westinghouse	6,456	6,642
British Thomson-Houston	6,350	6,494
Johnson, Lundell & Co.	5,164	5,294
GERMAN—		
Lahmeyer Electric Co.	5,370	5,502
British Schuckert Co.	4,837	5,027
Witting Bros. & Co.	4,464	4,781
Von Kramer	4,542	4,680
Frank Suter & Co.	4,020	4,078
BELGIAN—		
International Electrical Engineering Co.	4,400	4,460

The foreign tenders, viz., the German and Belgian, were struck out by the committee, and, after consideration, the tender from Messrs. Dick, Kerr & Co. was accepted.

A tender for a combination street-cleaner to work over the electric tramway lines, from Messrs. Dick, Kerr & Co., at £600, was accepted.

Fulham.—The Borough Council has accepted the ollowing tenders for the electricity works:—

BOILERS.—Davy Bros., Limited £2,028
MAINS.—British Insulated Wire Company .. .. .. £2?,689

Glasgow.—The Corporation Tramways Department have ust settled the following contracts for tramway extensions:—

2,000	tons steel rails, Bolckow, Vaughan & Co., Ltd.,	at	£6 9 6
100	,, fish plates	,,	7 19 6
1,150	,, steel rails (Belgian) P. & W. McLellan, Ltd.	,,	6 4 11
350	,, Curved steel rails (Belgian) ,,	,,	6 4 11
75	,, Fish plates (Belgian) ,,	,,	7 4 11

elivery of English rails to commence immediately and Belgian rails in March.

Permanent way contracts to the extent of £37,000 have been let to Messrs. Daniel Murray, A. and J. Faill, and A. Stark & Son. The overhead work will be carried out by the Department, but the following material has been contracted for:—Steel poles, Messrs. Wilson's and Union Tube Company, Limited, £11,663; trolley wires, Messrs. John A. Roeblings, Sons & Co., £2,422; trolley wire fittings, Messrs. R. W. Blackwell & Co., Limited, £1,610; malleable, cast, wrought-iron, and steel fittings, Messrs. R. W. Blackwell and Co., Limited, £1,718; guard and span wires, Messrs. R. W. Blackwell & Co., Limited, £129 13s. 10d. These figures are based on estimates, and are subject to amendment should it be found that certain of the new lines cannot be finished this year.

All the above are for the following extensions, for which tenders were recently invited:—Alexander Park to Riddrie, Cathcart Road to Cemetery Gate, Springburn to Bishopbriggs, Shieldhall to Renfrew, and they embrace close on 5 miles of roadway.

Manchester.—The Electricity Committee has recommended the Council to accept the tender of Messrs. Ferranti, Limited, for the supply of switchboards for Mr. Metzger's extension of the Stuart Street generating station and the sub-stations connected therewith; also the tender of Mr. E. Nuttall for the construction of the third and final section of the cable subway from Stuart Street. This portion runs under the canal. The tender of the New Conveyor Company was approved for the supply of coal conveyors for that part of the Stuart Street station which is under Dr. Kennedy's scheme.

Oban.—With reference to the published results of tenders for this place, the International Electrical Engineering Company are supplying the three dynamos, spare armature, &c., to the successful tenderer, Messrs. James Howden & Co.

Spen Valley.—The B.E.T. Co., who are promoting a tramway scheme for the greater part of the heavy woollen district, have let the contract for the construction and laying down of rails, posts, and the apparatus generally to Messrs. Dick, Kerr & Co.

Stepney.—The B.C. has accepted the tender of the New Century Arc Light Company, Limited, for supplying and erecting 20 arc lamps and columns for the sum of £525.

Sydney (N.S.W.)—Are British electrical manufacturers doing the best they can to meet the increasing demand for electrical machinery in Australia? This question recurs to us once again in reading the following news of an important American contract which has been carried out at Sydney. We quote the item from the trade pages of the *Electrical World*:—"The central power station of Sydney City and Suburban Tramways, of Sydney, Australia, contracts for the initial equipment for which to the extent of over $1,000,000, have already been placed in America, is to be considerably extended in capacity, and specifications representing an expenditure of some $500,000 have been issued. It will be recalled that when Mr. Charles Oliver, the chief railroad commissioner of the New South Wales Government, which is constructing the Sydney electric traction system, was in the United States in August, 1900, he placed a contract valued at almost $800,000 for the complete equipment of a plant having a nominal capacity of 4,500 H.P. This equipment, the last of which has just been shipped from this side, consists principally of three 1,500 KW. General Electric generators; three direct connected 32 by 64 by 60 vertical cross-compound engines, built at the Allis plant at Milwaukee, and some $100,000 worth of piping, &c., from the Best Manufacturing Company, of Pittsburg, Pa. Prior to the letting of this contract, the Sydney power house was installed with four 850-KW. General Electric generators, and Allis horizontal engines of 850-H.P. nominal capacity. Up to date, therefore, contracts have been let for a plant of 7,900 H.P. nominal capacity. The specifications now requisitioned for are additional equipment of 6,000 H.P. The boiler plant already installed represents 8,000 H.P., there being 32 units of 250 H.P. each. These boilers are water-tube ones, of Babcock & Wilcox build. The specifications now ask for 24 additional boilers. The entire plant will, therefore, have a capacity of 14,000 H.P. The contract for the steel construction of the power house, which called for some 1,200 tons of structural steel, was undertaken by the American Bridge Company. It was the first contract ever awarded for a steel structure in the Antipodes. The power house will be extended shortly. Besides the important installation before mentioned, everything required in the construction of the Sydney system other than the car bodies, which are being built in Australia, owing to the cheapness of wood in that part of the world, will be purchased in the United States, and before the entire system is an accomplished fact some $3,500,000 will have been expended."

Woolwich.—The Borough Council has accepted the tender of Messrs. Everett, Edgecumbe & Co., at £526, for measuring instruments.

FORTHCOMING EVENTS.

Friday, February 7th.—At 8 p.m. Institution of Junior Engineers. Meeting at the Westminster Palace Hotel. Paper on "The Electric Passenger Elevator," by Mr. William J. Cooper.

At 7.30 p.m. North-East Coast Institution of Engineers and Shipbuilders. Meeting in the Lecture Hall of the Literary and Philosophical Society, Westgate Road, Newcastle-upon-Tyne. Paper by Mr. D. B. Morison on "Report on Memorandum submitted to the First Lord of the Admiralty on July 16th, 1901, with reference to the present unsatisfactory condition of the Engineer Branch or H.M. Navy."

Saturday, February 8th.—At 11 a.m. and 3 p.m. Institution of Electrical Engineers (Students' Section). Visit to the generating station of Central London Railway, Shepherd's Bush.

Monday, February 10th.—Institution of Electrical Engineers (Newcastle Section) Meeting. Paper on "Electrical Legislation and Finance," by Mr. H. W. Handcock.

Tuesday, February 11th.—At 9 p.m. Institution of Electrical Engineers (Glasgow Section). Meeting at the Institution of Engineers and Shipbuilders, 207, Bath Street.

At 7.30 p.m.—Institution of Electrical Engineers (Manchester Section). Meeting at Owens College. Paper by Mr. C. E. Stromeyer on "Steam Boilers."

Wednesday, February 12th.—At 7.30 p.m. Institution of Electrical Engineers (Birmingham Section). Meeting in the Physical Theatre of the University.

At 7.30 p.m. Institution of Electrical Engineers (Birmingham Local Section). The discussion on Dr. W. E. Sumpner's papers on "Alternate Current Diagrams" and "The Testing of Motor Losses," which was adjourned from December 11th, will be taken. Prof. R. Threlfall, F.R.S., member, will then give some electric furnace demonstrations.

Thursday, February 13th.—At 8.0 p.m. Institution of Electrical Engineers. Meeting at the Institution of Civil Engineers, Great George Street. "Researches on the Electrical Conductivity and Magnetic Properties of upwards of 100 different Alloys of Iron," by Prof. W. F. Barrett, F.R.S., and W. Brown, B.Sc., and "On some Conclusions deduced from the preceding Paper," by Prof. W. F. Barrett, F.R.S.

Friday, February 14th.—At 8.30 p.m. British Electro-Therapeutic Society meeting at 11, Chandos Street, W. See "Notes" to-day.

NOTES.

Copper Prices.—The price of copper has been jumping about a good deal since the close of January. Our curves on another page show the price on January 31st as just below £56. On February 3rd the settlement price was £56 5s.; on 4th inst. it was down to £53 15s.; and on February 5th the price was £52 7s 6d.

Naval Boilers.—The *Pall Mall Gazette* says that in spite of repeated experiments, the builders of his Majesty's ship *London* have failed to secure efficient service from the Belleville boilers of that fine ship. "She has been out on her long steam trial, after several previous attempts, but the usual symptoms of leaky joints developed themselves, and the *London* has put into Plymouth for repairs. Meanwhile the Admiralty Boiler Committee are still experimenting with water-tube boilers of other sorts, and the *Fantome* has been fitted with the Niclausse system. The naval correspondent of the *Glasgow Herald* takes comfort in the fact that these boilers give better results than the Belleville. He says:—On the low-power run the mean result was 339 I.H.P., with a coal consumption of 1·695 lbs.; while the sister ship *Espiegle*, with Babcock & Wilcox boilers, at 337 I.H.P., consumed only 1·53 lbs.; two Belleville boiler ships, *Mutine* and *Rinaldo*, at the same power, burning 1·86 and 1·90 lbs. respectively. On the second 30-hours' trial, at 75 per cent. of the full power, the Niclausse boilers ship, at 1,020 I.H.P., equalled that with the Babcock boilers, the rates being respectively 1·53 lbs. and 1·54 lbs.; while the Belleville ships named returned 1·72 and 1·60 lbs. On the full power, the Niclausse boiler ship did well again. Her power was 1,453 I.H.P.; speed, 13·63 knots; and coal consumption, 1·53 lbs. The *Espiegle*, with the Babcock & Wilcox boilers, consumed 1·70 lbs., and the two Belleville boiler vessels 1·63 lbs. and 1·61 lbs. respectively."

Marconi and Italy.—King Victor Emmanuel has just named Mr. Marconi Commander of the Order St. Maurice and Lazarus. Moreover, the Italian papers report that Mr. Marconi will shortly go to Italy. Lastly, still according to the Italian newspapers, the Marquis Solari—mentioned in the ELECTRICAL REVIEW for November 29 and December 6, 1901, in connection with wireless telegraphy in Italy—was charged to treat for the purchase of several sets of Marconi apparatus for installations along the coast and on the ships, the apparatus used by the Italian navy not being capable of ensuring secrecy with regard to messages. M. Solari has, therefore, bought—after having tried them in England—several sets of wireless telegraphy apparatus of the latest syntonic type (is syntony sufficient to ensure secrecy in dispatches?). Mr. Marconi has given up his patent rights with regard to these apparatus, but only on condition that the Italian stations shall not be visited by persons not connected with the Italian navy.

Electric Tramways and Goods Traffic.—"The Conveyance of Goods on Electric Trolley Lines" was the subject of a paper read by Mr. Alfred H. Gibbings, M.I.E.E., engineer in-chief of the South Lancashire Electric Traction and Power Company, Limited, before the Liverpool Engineering Society last week. The paper dealt more especially with the scope which the manufacturing districts of South-west Lancashire offered for the economic introduction and working of electric traction for goods traffic, as between the docks at Liverpool and the mills and factories of Lancashire. Mr. Gibbings showed that a much more expeditious transportation and delivery of goods could be made by electric trucks on tramways than by the present railway system, and at charges which for full loads would be only half of the present railway charges, and yet would leave a sufficient profit. There would also be a saving to district councils and other authorities, as the maintenance of the roads would be undertaken by the electric traction companies. From manufacturers' and traders' points of view the importance of the electric carriage of goods in Lancashire was incalculable, and the extensive possibilities which it foreshadowed, were, Mr. Gibbings said, of such great public interest that the scheme should not be allowed to fall to the ground on account of probable opposition.

New York Power Stations.—We reproduce from the columns of our American contemporary *Power*, the following very interesting table, which presents in a manner easy for comparison, some of the chief points regarding the steam plant equipments of four large New York electrical power stations:—

	Metropolitan.	Manhattan.	Kingsb'dge.	Edison.
Engines	11	8	16	16
Horse-power each, normal rating	4,000	8,000	4,400	5,200
" " maximum rating	6,000	12,500	7,000	8,000
Ratio maximum to normal	1·65	1·56	1·59	1·54
Aggregate normal rated horse-power	44,000	64,000	70,400	88,200
" maximum " "	72,600	100,000	112,000	128,000
Diameter high pressure cylinders	46 in.	44 in.	46 in.	43·5 in.
Diameter low " "	86 in.	88 in.	86 in.	75·5 in.
Volumetric ratio	3·5	4	3·5	6·02
Displacement per min. low pressure cylinders aggregate	332,795·8	506,843	484,0·6 6	707,149
Displacement per min. low pressure cylinders per normal H.P.	7·56	7·92	6·88	8·5
M.E.P. required to develop normal rated H.P.	30·31	28·94	29 31	26 96
Reheating surface each engine	—	1,544	—	1,'37
" " per normal H.P.	—	·193	—	·219
Boilers	87	64	60	56
Rated horse-power each	250	500	512	650
" " aggregate	21,750	34,000	30,720	36,400
Ratio boiler to engine H.P. normal rating	·49	·5	·436	·44
Heating surface aggregate	205,291 sq.ft.	335,570 sq.ft.	307,200 sq.ft.	364,000 sq ft.
" " per rated boiler H.P	9·44	10·5	10	10
" " " engine H.P.	4·67	5·24	4·36	4·37
Grate surface aggregate	3,991 sq. ft.	5,632 sq.ft.	6,600 sq.ft.	6,720 sq.ft.
" " per rated boiler H.P.	·183	·176	·21	·18
" " " engine H.P.	·0907	·088	·094	·0508
Boiler H.P. per sq. ft. of grate	5·45	5·68	4 65	5·4
Engine " " "	11·02	11·36	10·67	12·4
Ratio heating to grate surface	51·4	59 58	46 5	54·17
Working pressure	150	150	160	175
Chimneys	1	4	4	4
Height above lower grates	358 ft.	278 ft.	225 ft.	200 ft.
Internal diameter	22 ft.	17 ft.	14 ft.	17 ft.
Aggregate area	380·13	907·92	615·76	907 92
Area × √height	7,141 99	15,188 05	9,236·4	12,839 53
Ratio grate surface to chimney area	10 5	6 2	10·7	7 4
Feed water heating surface—Economiser	—	9',804	115 200	—
Exhaust { vacuum (primary)	—	—	24,000	—
Exhaust { atmospheric (secondary)	—	—	—	10,6'4
Aggregate heating surface	—	98,304	139,200	10,6'4
Aggregate per boiler H.P.	—	3·072	4·5	·293
Ratio boiler to economiser surface	—	3·41	2·7	—
" " total feed water heating surface	—	3·41	2·2	34·14
Condensers—Kind	Su face	Jet.	Jet.	Surface.
Number	11	8	4	16
Cooling surface aggregate	84,000 s. ft	—	—	147,'00 sq.ft.
" " per normal H.P.	1·6	—	—	1·77
Ratio boiler to condenser surface	2·33	—	—	2·47
Coal storage capacity	9,000 tons	15,000 tons	15,360 tons	10,000 tons
Per boiler H.P.	827 lbs.	937 lbs.	1,000 lbs.	549 lbs.

Street Openings.—In the House of Commons on 30th ult. Sir H. Vincent asked the Home Secretary if he could hold out any hope of steps being taken to prevent the streets in London from being taken up by gas, water, electric, and hydraulic power companies and various civic authorities without system, to the inconvenience of the public. Mr. Ritchie, in replying, said that the matter was engaging the active attention of the local authorities within whose jurisdiction it properly fell in the first instance. The Corporation of the City had deposited a private Bill in which they asked for powers to control the breaking up of the streets within their area. For the rest of London, the County Council were in communication with the borough councils, and hoped to be in a position shortly to put forward proposals for legislation giving them the necessary powers as central authority in this matter. Any such proposals would receive the careful consideration of the Government.

Incorporated Municipal Electrical Association.—A special general meeting of this Association will be held at the Westminster Palace Hotel on Friday, February 21st, at 3 p.m., to consider—

1. The best means of obtaining an alteration to the existing regulations controlling the repayment of loans borrowed for the purposes of electricity supply undertakings, whereby local authorities are compelled to repay during the construction of works.
2. The desirability, or otherwise, of deciding the percentage which should be allowed for the depreciation of electricity undertakings.
3. The desirability, or otherwise, of recommending local authorities to form a reserve fund for the replacement of obsolete plant, and for other purposes specified in the Electric Lighting Orders.

These subjects have had the earnest consideration of the Council, which considers them of very great importance.

Yorkshire College Engineering Society.—"Locomotive Boilers" formed the subject of a paper read by Mr. R. Waters before this Society on January 27th.

Electricity in the Navy.—The new battleships and cruisers proposed by the Admiralty are to adopt electrically-driven machinery more extensively. 100 volts at lamp terminals is the new standard voltage. Telephones are to be still further adopted, and some additions to the number of electrically-driven fans for ventilation, and electric capstans, are proposed.

Obituary.—Mr. J. B. Craddock, who was in the employ of the Natal Telegraphs, and was Postmaster of Ladysmith during the siege, died recently at Maritzburg from privations endured during the investment.

The Electrical Volunteers.—We understand that the Corps of Electrical Engineers, R.E. (Vol.), have been asked if they can furnish a sixth detachment for active service in South Africa. Examination and provisional selection will take place probably on Saturday, February 15th. Intending applicants for enrolment should send in their names at once to the O.C., Electrical Engineers, R.E. (Vol.), Headquarters, Regency Street, S.W., giving full details as to their technical qualifications, age, height, chest measurement, &c. Regulations as to enlistment and pay as follows:—

Enlistment for the remainder of the war, but should the war terminate within one year, men have the option of completing one year's service, or taking their discharge at once.

Pay varies according to rank, and engineer pay according to skill.

Pay.—Sapper, 1s. 4½d.; corporal, 2s. 9d.; sergeant, 3s. 6d. a day. Engineer pay in addition to above:—Fair tradesman, 8d.; skilled, 1s.; superior, 1s. 4d.; very superior, 1s. 8d. a day for days employed.

The following gratuities are payable on discharge:—Volunteer gratuity, £5; War Office gratuity, £5.

Personal.—Last Sunday week the members of the Waterville staff of the Commercial Cable Company assembled in their Recreation Hall to wish "God-speed" to Messrs. Parish, Blackley, Jenkins, and Nickolds—all of whom have severed their connection with the Commercial Cable Company to take up service under the Pacific Cable Board, their destinations being Suva, Fiji Islands, with the exception of Mr. Jenkins, who goes to Brisbane as senior operator. Mr. Parish goes out to Suva as head superintendent, and Mr. Blackley is appointed assistant superintendent at the same station. Mr. Parish was the recipient of a gold watch, Mr. Blackley a gold chain, Mr. Jenkins a handsome dressing bag, and Mr. Nickolds a rifle. It was also announced that Messrs. T. Price and Scott had also been accepted by the Pacific Cable Board for Suva, this bringing the total of departures to six from Waterville.

The *British Australasian* for January 30th says that Mr. A. J. Arnot, who has been city electrical engineer at Melbourne for 10 years, is now about to proceed to England to take up a new and important position. He was entertained at a smoking concert at the Melbourne Town Hall on the 18th ult.

It is stated in the *Financier* that Mr. C. Gerhardi, of the Direct Spanish Telegraph Company, is shortly to celebrate his 50th year of service in submarine telegraphy.

The directors of the Windermere and District Electricity Supply Company, Limited, have appointed Mr. Christopher Walker, of Windermere, secretary to the company.

Mr. J. Shaw, manager and engineer to the Isle of Man electric tramways, and consulting engineer to the Douglas Corporation tramways, has been appointed resident electrical engineer of the Mersey Tunnel Railway Company.

Appointments Vacant.—Resident electrical engineer for Stoke-upon-Trent; assistant engineer at Fulham electricity works (£104); shift engineer for Bedford; switchboard attendant for Carlisle; assistant engineer for York (£150); borough electrical engineer for Croydon (£400 to £600); the Poplar Council wants a clerk (£150) for the electricity department; a tramways manager is wanted for the Oldham Tramways Committee; general traffic manager for the Wolverhampton electric tramways at £250; a junior assistant, and improver for Watford electricity works. See "Official Notices" to-day.

The British Electro-Therapeutic Society.—The next meeting of the British Electro-Therapeutic Society will be held at 11, Chandos Street, Cavendish Square, W., on Friday, February 14th, at 8.30 p.m., Dr. W. S. Hedley in the chair. Dr. Samuel Sloan (Glasgow) will show his "Faradimeter"; Dr. Geo Herschell will give a demonstration on a "Modern Induction Coil"; Dr. Lewis Jones will read a paper on "Electro-Therapeutics."

Consulting Engineer's Action Withdrawn.—The *Caterham Weekly Press* understands "that the action for slander brought by Mr. Medhurst, the borough consulting electrical engineer, against the mayor of Reigate (Mr. F. E. Barnes, J.P., C.C.), has been unconditionally withdrawn."

Institution of Electrical Engineers (Dublin Section).—At yesterday's meeting the adjourned discussion was to take place on Mr. W. Brew's paper on "Notes on Inductive Circuits."

An American Opinion on the Polyphase Arbitration.—Writing on the recent Underground arbitration, the *Street Railway Journal* remarks in connection with the objections made against the Ganz system, that it knows no successful device against which so many plausible and logical objections could be raised as the multiple unit system of control, which is in every day use; but it works, and there is the end of the matter. The inference is that, even from an American point of view, the Ganz system is not to be sniffed at, though at the same time the journal thinks that the onus of proof for the concatenated system of control rests with the Ganz Company, who ought to shoulder the responsibility. Messrs. Ganz have either solved the problem of practical speed control of polyphase motors, or they have not. If they have, the sooner engineers know it the better. Apart from the question of the Underground system, we do think that as soon as possible the polyphase system should be tried on what may be called main line railway work, for it does certainly offer a *prima facie* prospect of working a large area of country from a single central point, whence a sufficient load can be carried to ensure that first essential (of economical working—a good load factor. The journal, of course, refers to the polyphase system simply as regards the direct use of the currents upon the motors of the cars without any intermediation of rotary converters to direct currents. In America the tendency has appeared to be in the direction of new inter-urban electric lines on their own right of way, and not on the public highways, rather than in the electrification of existing steam railroads. Electricity has come in as a competing agent rather than as an aid to improvement of older services. This is a point that ought to be carefully and seriously pondered by the English railways. Their management has not been such as to so endear them to the public that they can afford to be too independent. The blow that has come so unexpectedly upon the Undergound of London through the competition of the Central London was unexpected only to the railway directors. The travelling public, if they thought at all, foresaw what would happen so far as they personally were concerned. The one hope for the Underground is the fact that it runs so near the surface as to be a well ventilated line if worked electrically, whereas the deeply buried tubes are far from perfect in this respect, and will continue to be so unless means be taken either positively to withdraw foul air or to compel it to escape vertically when propelled by the trains, in place of being circulated horizontally as is now the case.

THE CENTRAL STATION ENGINEER.

The staff of the Aberdeen Corporation Electricity Works held a smoking concert in the Bonaccord Hotel, Market Street, on January 23rd, when Mr. T. Wilkinson, electrical tramway assistant, was made the recipient of a couple of handsome chairs on the occasion of his marriage. Mr. Bell, the city electrical engineer, presided, and, in a few well-chosen words, made the presentation. Mr. Wilkinson suitably replied. A very enjoyable evening was spent, with songs, speeches, recitations, and instrumental music contributed by the staff and their friends, Mr. William Stewart ably accompanying on the piano.

On Monday, January 12th, the staff of the Hammersmith electricity works presented Mr. F. Hill (chief assistant) with a handsome tantalus on the occasion of his marriage. Mr. G. G. Bell (chief engineer), after a short speech, made the presentation. Mr. Hill thanked the staff in a few well-chosen words, and the event was brought to a close with three hearty cheers for Mrs. Hill.

Last week, Mr. Norman, mains superintendent of the Harrogate electricity department, who is shortly leaving for South Africa, was presented by the officials of the Corporation and the workmen of the electricity staff with a handsome dressing bag. There was a large and representative gathering, and Mr. Wilkinson, the borough electrical engineer, testified to the energy and zeal Mr. Norman had displayed in carrying out his duties. Mr. Norman, who was very warmly received, thanked the donors for the mark of esteem with which they had honoured him.

The Southampton Corporation has sanctioned the increasing of the salary of Mr. F. R. Bridger, chief assistant at the electric light station, from £150 to £180 per annum. The salary of Mr. H. L. Mills, mains superintendent in the electricity department, was also raised from £150 to £170.

NEW COMPANIES REGISTERED.

Trafford Power and Light Supply (1902), Limited (72,601).—This company was registered on January 27th with a capital of £150,000 in £1 shares, to take over the business of the Trafford Power and Light Supply, Limited (incorporated in 1899), to adopt an agreement with the said old company, to manufacture, distribute and supply electricity and gas for light, heat or motive power, to supply light, heat and power to towns, docks, railways, tramways, theatres, public and private buildings, trains, motor cars, ships, launches, or other places or things, and to carry out any necessary works. The first subscribers are: R. Mond, 27, Berkeley Square, W., and 39, Victoria Street, S.W., manufacturing chemist, with 250 shares; W. C. J. Fawcus, Red House, Altrincham, engineer, with 250 shares; W. Taylor, Throttle Nest House, Old Trafford, Manchester, C.E., with 250 shares; H. Edmunds, Antron, Upper Tulse Hill, S W., engineer, with 250 shares; W. F. Agnew, 20, Stafford Terrace, Kensington, barrister, with 250 shares; P. Brownsword, Thorn Villa, Heaton Moor, near Stockport, articled clerk, with 1 share; and R. P. Whitehurst, 11, Heath Street, Cheetham Hill, Manchester, clerk, with 1 share. If shares offered to public, no allotment unless whole of shares first offered be subscribed. The number of directors is not to be less than 3 nor more than 7; the first are William F. Agnew, Henry Edmunds, William P. J. Fawcus, Walter Taylor and Robert Mond; qualification £250; remuneration £1,000 per annum, divisible. Registered office, Electric Generating Station, Trafford Park, Manchester.

Sanitas Electrical Company, Limited (72,615).—This company was registered on January 28th, with a capital of £4,000 in £1 shares, to acquire from R. Otto and K. Otto, of Berlin, the benefit of certain inventions relating to apparatus for curing diseases by means of light, and to manufacture and deal in medical and other appliances (whether electrical or otherwise), light baths, &c. The first subscribers are:—R. Otto, 22A, Luisenstrasse, Berlin, merchant, with one share; K. Otto, 22A, Luisenstrasse, Berlin, merchant, with

one share; W. H. Schwedler, 19, Kirchstrasse, Berlin, merchant, with 1,000 shares; J. K. A. Hoffmann, 19, Kirchstrasse, Berlin, merchant, with one share; H. O. H. Wiskemann, 6, Abchurch Yard, E.C., merchant, with one share; E. W. L. U. Peters, 55—56, Chancery Lane, W.C., solicitor, with one share: and Miss E. Robinson, 143, Mare Street, Hackney, with one share. No initial public issue. The number of directors is not to be more than three; W. H. Schwedler is the first; remuneration £150 per annum.

Roger Dawson, Limited (62,635).—This company was registered on January 30th, with a capital of £2,000 in £1 shares, to acquire the business carried on at 8, Berners Street, Oxford Street, W., as "Roger Dawson," and to carry on the business of electricians, mechanical engineers, producers and suppliers of electricity for power and light, &c. The first subscribers (each with one share) are: G. H. Dyke, 5, Bedford Row, W.C., secretary; W. H. Stephens, 33, Lansdowne Gardens, Clapham Road, S W., clerk; A. R. Dawson, 8, Berners Street, W., electrical engineer; H. Jackson, 8, Berners Street, W., electrical engineer; C. F. Twist, 5, Bedford Row, W.C., solicitor; O. Nettlefold, 54, High Holborn, W.C., merchant; and C. W. de Lyons-Pike, 87, Bedford Row, W.C., solicitor. No initial public issue. Registered without articles of association.

Buckholtz Engineering Company, Limited (72,589).—This company was registered on January 27th, with a capital of £2,000 in £1 shares, to carry on the business of mechanical and electrical engineers, manufacturers of and dealers in tools, instruments and accessories for mechanical, electrical, and hydraulic engineers and pewterers, lighting contractors, agents for hardware, domestic novelties, and labour saving appliances, &c. The first subscribers are:—C. W. Forward, Redleaf, Wilton Crescent, Wimbledon, gentleman, with 100 shares; W. S. Cott, 3, Wilton Crescent, Wimbledon, gentleman, with 100 shares; J. Finch, 20, Egerton Gardens, Ealing, publisher, with one share; E. Buckholtz, 315, Boro' High Street, S.E., electrical and mechanical engineer, with one share; Mrs. A. Scott, 3, Wilton Crescent, Wimbledon, with one share; C. W. Bennett, 8, Mayfield Road, Wimbledon, Commander P. & O. Company, with one share; and Mrs. L. Forward, Redleaf, Wilton Crescent, Wimbledon, with one share. No initial public issue. Table "A" mainly applies.

CITY NOTES.

Central London Railway.

MR. H. TENNANT presided on Wednesday at the Holborn Restaurant over the half-yearly meeting of the shareholders of the above railway, in the absence through illness of Sir H. Oakley.

In moving the adoption of the report, the CHAIRMAN said the capital expenditure, which included that owing to the contractors for works and machinery, was now £3,681,312, and the receipt for stock and debentures was £3,562,551, leaving a debit on capital account of £118,960. That debit was more than covered by the capital powers the company possessed. As regarded the revenue accounts, they had received during the half-year £162,816 for the conveyance of passengers, and £5,443 for miscellaneous receipts; a total of £168,359. The working expenses amounted altogether to £90,544, which was rather under 54 per cent. of the receipts. In looking at the cost of the working of the undertaking, they must bear in mind that not only had their passengers to be carried on the railway, but practically everyone had to be lowered and raised by the lifts, so that if they carried 20,000,000 passengers, it meant that twice that number made use of the lifts. The working and repair of those lifts involved a considerable outlay, and if the cost of the lifts could be eliminated, the proportion of working expenses to receipts would be reduced rather over 4 per cent. But the lifts were a necessary adjunct to underground railways of the type of the Central London, and no necessary expenditure to secure the good working order of the lifts, so as to ensure safety, had been spared. There were 20,802,650 passengers carried during the half-year, but as the line was not open for the whole of the corresponding portion of last year, no comparison could be made. Comparing, however, the number with that carried in the June half-year, there was an increase of 416,911, of which upwards of 300,000 appeared to be workmen. The average fare paid was 1·88d. per passenger, so that about 2½ millions of those carried were supposed to be workmen, who only paid 1d. for the journey. The public denominated their railway the "two-penny tube," but if they had only got 2d. from each passenger, their revenue would have been greatly increased. A comparison of the increase with the June half-year was not much use, because, contrary to the case of other railways, the summer months were the worst months for them. As compared with the past half-year, their miscellaneous receipts showed a slight increase. He daresay they would have observed that their stations were only one storey, but the foundations were strong enough to bear a superstructure, and in the course of time most of the stations would be utilised in that way, and would bring in a considerable rental. The Post Office and the Museum stations had already been arranged for. With regard to the expenses, £544 had been paid for compensation, which was in consequence of small mishaps to a few passengers, and also included workmen's compensation. As the public became more used to the line, it was believed these small mishaps would be less. With regard to the question of vibration, the company had made experiments, and afforded all facilities to the experts appointed by the Committee of the Board of Trade which had sat to consider that matter. As far as they knew, the Committee were satisfied with the manner in which the company had met the investigations. He could only say that when the Committee's report was published, the board would carefully consider it in all its bearings. Dealing next with the money available for distribution, the chairman said they, too, recommended the payment of 4½ per cent. on the ordinary shares, the placing of £10,000 to reserve, and the carrying forward of £5,874. Being a young company they thought prudence dictated that a reserve should be formed. Coming to the business which it was proposed to transact at the special meetings, the shareholders would remember that last year they brought a Bill before Parliament for two purposes. One was to make curves at either end of the line, and the other was for the purchase of land to provide additional lifts at Shepherd's Bush. The part of the Bill relating to the loop lines was suspended, but the other part was carried, and they were empowered to raise £150,000 additional capital. It would require a resolution for the shareholders to issue that capital. They were proceeding with the lifts at Shepherd's Bush, where there had been a great development of traffic, as quickly as possible. They could have brought up the suspended part of their Bill that session without going through the preliminary stages. There were a large number of underground Bills before the Joint Committee, which considered the whole question of tube railways, and the Committee felt that the Central London Company ought to take a larger view of the requirements for travelling between the City and the suburbs, and in their report they said they were of opinion that there should be one through line from Hammersmith along Piccadilly to the City. Under the circumstances the Board came to the conclusion that, if it could be done, it would be very desirable to secure an improvement in the working of the Central London Railway in combination with the provision of railway communication between Hammersmith and the City. Accordingly they had an inquiry made by their experts into the question of having a railway so as to complete a complete circle, so that trains could be continuously run without loss of time for shunting and changing engines. Having carefully considered the whole matter, the directors had decided to abandon the suspended Bill, and to promote a new Bill for the construction of a line from Hammersmith to the City. The new line would be connected with the existing line by curves at both ends. It was evident that this would give the greatest facilities to the public, and as the Central London Railway had a generating station capable of extension at Shepherd's Bush, the directors believed that they could carry out the provision of the new line more advantageously than any other company. The proposed new line would commence with a junction with the existing line at Shepherd's Bush, and would run under Goldhawk Road, Grove Road, Hammersmith Broadway, Hammersmith Road, Kensington Road, Knightsbridge, Piccadilly Circus, Leicester Square, King William Street, Fleet Street, Ludgate Circus, Upper Thames Street, Cannon Street, Queen Victoria Street, under the existing railway at the Bank to Liverpool Street by way of Cornhill, and by joining the existing railway in Old Broad Street complete the circle. On the combined undertaking there would be 29 stations. Power would be taken to raise £3,000,000 by shares and £1,000,000 by borrowing. He thought immense advantages would be obtained by combining the undertakings.

Lord COLVILLE CULROSS seconded the motion.

Mr. JARVIS expressed disappointment at the dividend. He thought they ought not to carry people 6¾ miles for 2d, while similar railways charged 4d. for a less distance.

Mr. WALFORD thought it would not be a good thing to alter the fares at the present time, seeing that they were going to Parliament for another Bill. He believed there were four opposition schemes with regard to Piccadilly.

Mr. H. E. JENKINS observed that they would undoubtedly soon be in competition with motor cars and omnibuses, and that it was only by low fares they would obtain traffic.

Mr. MATESDORF pointed out that it was evident that the workmen's traffic did not pay, and they must view the large increase in that class of traffic with alarm.

Mr. CARLILE wished to know what provision was made for the safety of the passengers in the case of an accident.

Mr. HOWE asked if they could make any discrimination with regard to workmen.

Mr. FITCH called attention to the temperature of the tunnels. He said there was was a temperature of 66 with no air at all.

The CHAIRMAN, in reply, said he thought it would be better for them to have a little more experience before altering the plan of having a uniform fare, and with regard to the workmen's fares, they thought it better to make no change at present. Experience might, however, result in very careful consideration being given to the subject. As to ventilation, they were making some little experiments, but observations had shown that the atmosphere was not so depreciated as in an ordinary room. With regard to safety, he might assure them that no precautions would be spared to make the line safe to the public, and to give them the greatest confidence.

The report was carried, and at subsequent special meetings, the necessary resolutions with regard to the issue of capital, and the approval of the Bill before Parliament, were carried.

St. James's and Pall Mall Electric Light Company.

THE directors' report for 1901, which will be submitted to the ordinary general meeting to be held at the offices, Carnaby Street central station, Golden Square, W., on Tuesday, 11th inst., at 3 o'clock, reads as follows:—

The directors submit their report for 1901, with the accounts as certified by the company's auditors, and the auditors' report. The extensions of Carnaby Street station were completed in readiness for the winter season, and supply was made on a total of 211,827 8-C.P. lamps, being an addition of 25,480 in the past 12 months. The high price of coal, and the large addition to the rating of the company's property, have raised the cost per unit of electricity generated; but owing to the growth of the business, and to further economies, the result of the year's trading has not been injuriously affected. Considerable progress has been made in the works of the Central Electric Supply Company, at Grove Road, and the trunk mains connecting with this company's system have been completed

By a resolution of the extraordinary meeting held on February 12th, 1901, confirmed at a subsequent meeting on March 5th, the articles of association of the company were altered, in order to bring them into comformity with the Companies' Act, 1900, and the present constitution of the capital of the company. By an order of the Chancery Division of the High Court, made on June 15th, 1901, the memorandum of association of the company was altered, in conformity with a resolution passed by an extraordinary meeting of the company held on May 6th, and confirmed at a subsequent meeting on May 21st, to enable the company to guarantee the repayment of principal moneys and interest secured by debentures, mortgages, stocks, or obligations of certain other companies. This company bas guaranteed, jointly with the Westminster Electric Supply Corporation, the payment of the principal and interest on an issue of £250,000 4 per cent. guaranteed debenture stock of the Central Electric Supply Company, Limited. For the information of shareholders, an abstract of the accounts of that company is enclosed. The interest charged on advances made to the Central Electric Supply Company, Limited, and credited to interest suspense account at December 31st, 1900, has now been received. This interest, amounting to £2,559 16s. 7d., after the deduction of income-tax, has been transferred from the suspense account to the credit of capital reserve fund, the balance on which now amounts to £69,089 1s. 10d.

The net earnings of the company for the year 1901 were		£36,632	7 5
Add balance brought forward from 1900		1,801	17 3
		£38,434	4 8
Less interim dividend paid in August last for half-year ending June 30th, at rate of—			
7 per cent. on preference shares	£3,500 0 0		
10 per cent. on ordinary shares	10,000 0 0		
		13,500	0 0
Leaving an amount now to be dealt with of..		£24,934	4 8
The directors propose to divide this amount as follows:—			
(*a*) By payment of a dividend at the rate of 7 per cent. on the preference shares for the second half of the year		£3,500	0 0
(*b*) By payment of a dividend on the ordinary shares for the second half-year of 7s. 6d. per share, and a bonus of 2s. per share, making, with the interim dividend paid on August 1st last, a total distribution of 14½ per cent. for the year		19,000	0 0
(*c*) Amount to be carried forward		2,434	4 8
		£24,934	4 8

The Liverpool Overhead Railway Company.

THE directors' report for the half-year ending December 31st, 1901, to be submitted to the meeting to be held at Liverpool on Tuesday, February 11th, at 12 o'clock, reads as follows:—

In presenting the half-yearly statement of capital and revenue accounts to December 31st, 1901, the directors have to report that the gross revenue receipts amount to £41,766 16s. 7d., and the working expenses to £29,896 19s. 11d.

The number of passengers carried during the last two years is as follows:—

	Half-year ending June 30th, 1900.	Half-year ending Dec. 31st, 1900.	Half-year ending June 30th, 1901.	Half-year ending Dec. 31st, 1901.
First class	635,449	716,095	721,999	708,740
Second class, including tramways	2,477,025	3,369,833	3,157,111	3,321,856
Workmen (special return tickets)	1,575,388	1,569,571	1,503,114	1,402,858
Total ..	4,687,862	5,655,499	5,382,224	5,433,454

There has been a falling off in the traffics during the past half-year, due mainly to the competition of the tramways, belonging to the Corporation, which approach the dock system at several points. The directors have to express their great regret that a serious accident, through fire, took place on the evening of December 23rd, at the Dingle Station, by which two passengers and four of the company's servants lost their lives. Every precaution has been taken, in reinstating the station, to guard against the recurrence of a similar disaster.

REVENUE ACCOUNT.

		£ s. d.
Receipts from passenger traffic amount to		40,790 6 3
Miscellaneous receipts and interest		976 10 4
		41,766 16 7
Less working expenses		29,896 19 11
		11,869 16 8
Deduct interest on mortgage debentures	£3,400 0 0	
Amount set aside to meet contingencies arising from accident at Dingle Station	3,000 0 0	
		6,400 0 0
		5,469 16 8
Add balance brought forward, June 30th, 1901		3,722 15 8
Leaving available for dividend		9,192 12 4

Out of this balance the directors recommend the declaration of dividends at the following rates (less income-tax), payable on and after February 14th, next:—

5 per cent. per annum on preference shares..	£3,000 0 0
1 „ „ ordinary shares	2,500 0 0

leaving a balance of £3,692 12s. 4d. to be carried forward to next half-year. The directors retiring by rotation at this meeting are Sir William B. Forwood and Mr. Harold Brocklebank, who, being eligible, offer themselves for re-election. The auditor retiring by rotation is Mr. George Nicholson, who is also eligible for re-election.

Blackpool and Fleetwood Tramroad Company.

THE report of the directors for the half-year ended December 31st last, to be submitted to the meeting in Manchester on 21st inst., states that, including the sum brought forward, the balance of profit, after providing for debenture interest, is £10,555, and the directors recommend a dividend at the rate of 9 per cent. per annum, which will absorb £6,750, writing off £1,500 to depreciation reserve, and £400 from the cost of application to Parliament for further powers, leaving a balance of £1,905 to be carried to the current half-year. The number of passengers carried during the half-year was 1,254,103, and the car mileage run 357,132 miles. The receipts from all sources amounted to £21,340.

Great Northern and City Railway Company.

SIR CHARLES SCOTTER presided over the meeting of this company at Westminster Palace Hotel on Tuesday, and in moving the adoption of the report, he said that the progress of the works was set forth therein, so that it was not necessary for him to deal with the matter in detail. Sir Douglas Fox had, however, that day sent him a report, in the course of which he summarised the position as follows:—"The total length of tunnels driven to date is 8,078 lineal yards of the 16 ft. tunnel, 876 lineal yards of station tunnel, and 43 yards of cross-over tunnel. There remains about 64 yards of the 16 ft. tunnel still to be driven, and only 8 yards of the cross-over tunnel." That, said the chairman, pointed in the direction that the line was getting very near completion, and certainly during this year the line as between Drayton Park station and Finsbury Pavement would be completed, and he hoped open for traffic. The question of electric traction had created almost as much controversy as the battle of the gauges in the old railway times. The speaker then referred at some length to the Metropolitan and District electrification arbitration, and said that the decision in favour of the continuous-current system was the only decision which could have been given after the expert evidence which had been heard. Mr. Parshall, the expert on behalf of the District Company, concurred, and Mr. Parker, who was the expert for the Metropolitan, did not dissent from the decision, and he did not wish to make a separate report, which practically meant that he concurred also. Before this arbitration was thought of, the G.N. and City Railway Company invited tenders for electric traction for their railway from firms in this country, in the U.S., and in Germany, and it was a very laborious work for Sir Douglas Fox, their engineer, to go through the tenders sent in. They had decided before the arbitration that they would adopt precisely the same system as was recommended by Mr. Lyttleton, and they had placed the contract with the British Thomson-Houston Company. They would be glad to know that as far as they were concerned the contract was placed in this country, not only for the power plant, but for the whole of the carriages and everything else in connection with the railway. In that contract provision was made for a three-minute service of trains each way between Finsbury Park and Finsbury Pavement, and in addition to that they would have an ample margin of power for contingencies. They would be able to work trains up to a weight of 197 tons; the carriages would be much larger and more roomy than those on either the Waterloo and City or the Central London Railways, the larger size of the tunnels of course, rendering this possible. The power station would be situated at Poole Street, on the Regent's Canal, about the centre portion of the railway. They would obtain their water supply from the canal, and by water communication they would obtain their coals and heavy materials at the most reasonable rate. The chairman then referred in some detail to the agreement this company had been able to enter into with the Great Northern Railway. It was originally intended to run this railway from Drayton Park over the railways of the G.N. Railway, into their Finsbury Park station, and the G.N. Co. were under an obligation to find the necessary accommodation for this company at Finsbury Park station, and give running powers over their railway into the station. When they came to look into the question seriously they found that, as a matter of working, it would have been almost impossible to have worked a continuous, regular, and punctual service over the rails of another railway company, besides which the receipts arising from that particular portion of the railway between Finsbury Park and Drayton Park stations would, of course, have belonged to the G.N., and not to the G.N. and City; the only proportion that this company would get out of the receipts would be the bare working expenses (probably 25 per cent.), so that 75 per cent. of the receipts arising from that traffic would have gone to the G.N. Railway Company, in addition to which they would have had to pay a rent for the use of the Finsbury Park Station and interest upon any outlay which the G.N. Company had to expend in order to provide the necessary accommodation for this company's trains running into and out of Finsbury Park Station. They came to the conclusion that it would be cheaper in the long run if they had their own independent line under the G.N. Railway and their own independent station under Finsbury Park Station, just as the Waterloo and City Railway was under the Waterloo Station of the South-Western Railway. They had now made an agreement whereby the G.N. Railway should make this line under their railway and under their station, and that they should lease it to the Great Northern and City for 999 years. For that period the line would be practically the property of the Great Northern and City, and all this company would pay for that railway was 3 per cent. upon the capital. That was the best possible thing for this company, and the agreement had been signed and sealed this week.

The Earl of LAUDERDALE seconded the adoption of the report, which, after a few general questions had been asked and answered, was carried unanimously.

The retiring directors and auditors were re-elected, and a vote of thanks was passed to the chairman and directors.

At a subsequent Wharncliffe meeting, resolutions were passed approving of the following Bills, which are to be introduced into Parliament this session:—

1. A Bill to confer further powers on the Great Northern and City Railway Company, and to extend the time for the completion of the authorised railway of that company, and for other purposes.
2. A Bill to empower the Great Northern Railway Company to construct an underground railway in Islington, and to lease the same to the Great Northern and City Railway Company, and for other purposes.

The Chairman explained that with regard to the proposed new station at Highbury, mentioned in their Bill, the district was densely populated, and the district authorities had appealed to them to put down a station there. They had included powers, therefore, in their new Bill, but they did not say that they were going to build a station at Highbury at present; they would get powers to do so in case they found it necessary. In regard to the extension to Lothbury, if they could get authority to run from Finsbury Pavement to that point, it was a most important addition, and they should be able to double their traffic through it.

Charing Cross, Euston and Hampstead Railway Company.

In the absence of Mr. C. T. Yerkes, through indisposition, Mr. W. T. Potts presided at the half-yearly meeting of this company on Tuesday last.

The Chairman moved the adoption of the accounts, which showed a slight increase in the money on deposit.

Mr. J. R. Chapman seconded, and it was agreed to.

The meeting subsequently became special and approved the following Bills:—

1. A Bill for conferring further powers upon the Charing Cross, Euston and Hampstead Railway Company with respect to their undertaking, for authorising agreements with the Metropolitan District Railway Company, the South-Eastern and Chatham Railway Companies' managing committee, the South-Eastern Railway Company, and the Baker Street and Waterloo Railway Company, and for other purposes.
2. A Bill to confer further powers on the Brompton and Piccadilly Circus Railway Company, for the construction of new railways and works and for the use of part of the Metropolitan District Railway, to extend the time for compulsory purchase of land and completion of works, and to authorise working and other agreements with other companies, and for other purposes.

Metropolitan Railway Company and Electric Traction.

At the half-yearly meeting of the Metropolitan Railway Company last week, Colonel J. J. Mellor, who presided, said that he hoped that nothing would occur to prevent the early adoption of electric traction. At the last half-yearly meeting he pledged the board that whatever the decision of the Board of Trade was they would at once carry it out in a frank and loyal spirit. With that object they put themselves in communication with the District Company even before the award was announced. The shareholders, no doubt, had seen the offer which the Traction Company had made to supply the Metropolitan with current at ·85 of a penny per unit, and also the reply of this board that they could manufacture it for themselves on their own land at Neasden, close to their works, where all their electrical repairs would have to be done, at about half the price quoted by the Traction Company. The erection of their own works at Neasden would not mean an unnecessary duplication of capital. Their consumption would be so large and their works would be on so big a scale that they could produce the current at the lowest possible figure. If this company did not put down the power plant at Neasden the Traction Company must put it down at Chelsea. Well, the board preferred to put it down for themselves, and get it at ground-floor price. In fact, they had now under consideration two tenders, both of which he believed were based on terms more advantageous than had ever yet been secured by any other company. The delay of a year, if it had lost them something in certain directions, had profited them much in others, for they would not only effect a considerable saving in the contract price, but the knowledge they had gained by the experience of other companies during the past 12 months would be invaluable to them. But there were other drawbacks which accounted to some extent for the high price the Traction Company proposed to charge them. In the first place, they were only just acquiring the land under compulsory powers. He expected the price of the site at Chelsea would be enormous. At Neasden they had any quantity of land secured some years ago on very low terms, and which would not cost this company a penny. Then again, at Neasden the cables would be carried the whole length of the railway and, in any case, they must sooner or later erect a power house there for their traffic to Harrow and Northern extensions. Those considerations were of the first importance, apart from a great saving in the cost of the current. Their consumption would be so big that even the addition of one-tenth of a penny would cost the company £29,000 a year. With regard to the proposal of the Traction Company to guarantee this company a certain percentage on its ordinary stock, Messrs. Price, Waterhouse & Co. said:—"Unless the security offered by the guaranteeing company can be proved to be absolute, and unless the future earning power of the ordinary stock cannot be put at more than 3½ per cent. per annum, the proposition does not appear to commend itself." He thought they would agree with him that it would have been extremely unwise on the part of the board to have handed over their valuable properties and their 13 millions of capital to a limited company involved in a variety of speculative undertakings. A fusion of interest with the District Company on an equitable basis was a project which they would all be more than willing to consider, but if they could not have such an equitable fusion, then let them have the next best thing possible, the closest and most friendly working union which it was possible to bring about. That, at least, they could have to the great convenience of the public, to the improvement of their traffic, resulting in great good and no little saving to both companies. All this they could have without the risk of their earnings being sacrificed in order that the property of another company might be improved. The tunnels of this company were far superior to those of the "tubes" now running, and when the line was electrified and the tunnels beautified, London would not know its underground railways.

Cambridge Electric Supply Company.

The report of the directors to be presented to the meeting at Cambridge on Wednesday, February 12th, at 3 o'clock p.m., reads:—

The directors submit herewith a statement of the income and expenditure for the past year, and the balance-sheet showing the assets and liabilities of the company made up to December 31st last. They have pleasure in reporting that the progress of the company continues to be satisfactory. During the year 1901 there has been added to the company's mains the equivalent of 3,737 8-c.p. lamps, making the total 34,723. The number of units supplied has been 382,224, an increase of 24,789 units. The company, after paying all charges and placing £750 to depreciation account, has a balance of £5,019 10s. 4d., which, added to £38 10s. 10d. brought forward from last year, makes £5,058 1s. 2d. An interim dividend of £1,518 16s. 10d. and interest on temporary overdraft and loan (£340 5s. 3d.), have already been paid, leaving a net balance of £3,198 19s. 1d. Out of this the directors recommend the payment of a dividend of 4½ per cent., making, with 2½ per cent. already paid, 7 per cent. for the year. This will absorb £3,080 0s. 7d., leaving a balance to carry forward subject to fractional adjustment of income-tax, of £118 18s. 6d. The Hon. C. A. Parsons and Mr. Simpson retire by rotation; both are eligible, and offer themselves for re-election. The auditor, Mr. Arthur Rutter, also offers himself for re-election.

Anglo-American Telegraph Company.

The directors' report, to be submitted to the meeting to be held to-day, 7th inst., reads as follows:—

The total receipts from July 1st to December 31st, 1901, including the balance of £6,378 13s. 11d. brought forward from the last account, amounted to £185,278 19s. 7d. The traffic receipts show a decrease of £2,761, as compared with the half-year ended December 31st, 1900. The total expenses of the half-year, including the repair of cables, &c., as shown by the revenue account, amounted to £63,513 17s. 5d., being a decrease of £6,862 7s. 6d. over the corresponding period of 1900. The directors, under the powers conferred upon them by the articles of association, have, before declaring the net profits, set apart the sum of £12,000 to the renewal fund, leaving a balance of £109,765 2s. 2d. Interim quarterly dividends of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, were paid on November 1st last, absorbing £52,500, leaving a balance of £57,265 2s. 2d., out of which the directors recommend the proprietors to declare final dividends of 16s. per cent. on the ordinary stock, £1 10s. per cent. on the preferred stock, and 2s. per cent. on the deferred stock, amounting to £56,000, making a total distribution for the year ended December 31st, 1901, of £3 1s. per cent. on the ordinary stock, £6 per cent. on the preferred stock, and 2s. per cent on the deferred stock. The balance of £1,265 2s. 2d. will be carried forward to the next account. The cables and landlines of the company are in good working order. In accordance with the articles of association two directors of the company, Mr. F. A. Bevan and Mr. C. Burt retire at this meeting, and, being eligible, offer themselves for re-election. Mr. Ernest Cooper, F.C.A., and Mr. John Gane, F.C.A., the auditors, also retire and offer themselves for re-election.

Dublin United Tramways Company (1896), Limited.

The report of the directors for the half-year ended December 31st last, submitted at the meeting held in Dublin on 4th inst., states that the directors have declared a dividend for the half-year at the rate of 6 per cent. per annum on the pref. shares, and at the rate of 6 per cent. per annum on the ordinary shares. These dividends will absorb £34,949, leaving a balance of £4,668 to be carried forward, after writing off £1,000 from preliminary expenses. In addition to a full half-year's interest on the debentures, a further £1,891 has been charged against the revenue for the half-year, providing for all the interest under this head to December 31st, 1901. A sum of £1,475 in excess of the full half-year's "wayleaves," payable to the local authorities, has been similarly charged, so as to clear them up to the last gale days. The rates and taxes charged against the last half-year's revenue are £2,028 in excess of the corresponding period in 1900, and are fully charged up to December 31st, 1901. A policy has been effected with the English and Scottish Law Life Insurance Company to insure the payment to the company at the end of 38 years of the discount on the "B" debenture issue, and the premium for the half-year has been charged against revenue The directors have always considered that no charge should be made against revenue in respect of the large amount of obsolete property, such as cars, horses, &c., which were necessarily sold at a loss in connection with the conversion of the tramway system from horse to electric traction. This principle has been acted on in all similar undertakings of which the directors have any knowledge, but deferring to the views of the auditors, £8,049, part of the difference between the sum at which the horses stood in the books of the old company, and what they realised when sold, was charged against revenue and reserve, and the balance—namely, £7,076—was placed to a special suspense account, with a view of writing it off out of revenue in future half-years. The directors have now the authority of the auditors for saying that, in the event of the shareholders approving of this item of suspense being charged to capital account, the same as the losses incurred on all other items involved in the conversion of the tramway system, the auditors will offer no objection.

At the meeting of the Dublin United Tramway Company on 4th inst., Mr. W. M. Murphy, the chairman, said that the cost of the electric working was £14,990 in 1900, and £6,990 in 1901, a saving of £8,000. This item contained the whole cost of generating and distributing the electrical energy for working the tramcars. It worked out at ·564d. per

unit, including the engineers' salaries, and he doubted very much if this could be beaten by an electrical station in the kingdom. The total number of passengers carried in the half-year was 23,816,084, a record number, equal to the moving of the whole population every three days, while the cars had travelled a distance equal to five times round the earth in a week. The traffic receipts per mile were 8·70d., compared with 8·48d. in 1900, and the expenses 4·728d., as against 5·02d., the proportion of expenses to receipts being 51·88 per cent., compared with 56·09 per cent.

Brompton and Kensington Electricity Supply Company.—The directors announce a dividend at the rate of 9 per cent. per annum on the ordinary shares for the half-year to December 31st last, making, with the interim dividend already paid, 8 per cent. for 1901, carrying £7,000 to depreciation account and £2,961 forward.

British Electric Transformer Manufacturing Company.—Interim dividend for the half-year ending December 31st, 1901, at the rate of 10 per cent. per annum.

The Electric Lighting and Traction Company, of Australia.—The directors recommend the payment of a dividend of 6 per cent. per annum on the preference shares of the company for the year ended August 31st, 1901.

North Metropolitan Electric Power Distribution Company.—A meeting of this company was held at Surrey House, W.C., on Tuesday, but the proceedings were conducted in private.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending Jan. 31st were £577; corresponding week last year, £555; increase, £22. Total to date, £2,763; corresponding period last year, £2,421; increase £342. Miles of track open, 10¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending February 1st were £145; corresponding week last year, £143 increase, £2. Total receipts to date, £730; corresponding period last year, £675; increase, £55.

Bristol Tramways and Carriage Company.—The receipts for the week ending January 31st were £3,811; corresponding period last year £3,612; increase, £199.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending January 24th:—

Company.	Amount £	Comparison with corresponding week of last year. + £	Comparison with corresponding week of last year. — £	No. of weeks.	Aggregate. Amount. £	Aggregate. Inc. or Dec. + £	Aggregate. Inc. or Dec. — £
Croydon*	654	422	—	3½	2,169	1,358	—
Devonport	398	—	—	3½	1,391	—	—
Dudley-Stourbridge	614	104	—	3½	2,046	381	—
Gateshead	628	—	—	3½	2,122	—	—
Greenock-Pt. Glasgow	374	204	—	3½	1,240	625	—
Hartlepool	170	—	6	3½	594	16	—
Kidderminster ..	86	8	—	3½	302	30	—
Merthyr	192	—	—	3½	613	—	—
Oldham—Ashton ..	449	—	24	3½	1,544	—	102
Poole	176	—	—	3½	614	—	—
Potteries	1,347	43	—	3½	4,548	62	—
Southport	116	20	—	3½	406	48	—
South Staffordshire†	706	22	—	3½	2,389	118	—
Swansea	410	53	—	3½	1,359	111	—
Taunton	51	—	—	3½	177	—	—
Tynemouth	189	—	—	3½	643	—	—
Wolverhampton Dist.	131	88	—	3½	371	227	—

* Partly horse. † Partly steam.

Central London Railway.—The receipts for the week ending Feb. 1st were £6,684; corresponding week last year, £7,112 (includes Queen's funeral, Feb. 2nd, 1901); decrease, £428. Total receipts to date, £32,879; corresponding period last year, £30,678; increase, £2,201. Miles open, 6.

City and South London Railway.—The receipts for the week ending Feb. 2nd were £3,021; corresponding week last year, £1,962; increase, £1,059. Total receipts to date (5 weeks), £15,077; corresponding period last year, £10,010; increase, £5,067. Miles open, 6½; last year, 4½.

Dover Corporation Tramways.—The receipts for the week ending February 1st were £164 6s. 0½d.; corresponding week last year, £139 17s. 6½d.; increase, £24 9s. 0d. Total to date, £813 1s. 1½d.; corresponding period last year, £775 1s. 11d.; increase, £37 19s. 2½d. Miles of track open, 3. Car miles run, 1902, 5,102; 1901, 4,595. Number of cars, 1902, 12; 1901, 11.

Dublin United Tramways Company.—The receipts for the week ending January 31st were as follows:—D.U.T. Co., £3,167 12s. 11d.; D.S.D. Co., £635 12s. 8d.; total, £3,803 5s. 7d.; corresponding week last year—D.U.T. Co., £3,109 4s. 8d.; D.S.D. Co., £612 11s. 6d.; total, £3,721 16s. 2d.; increase, £81 9s. 5d.; aggregate to date, £18,186 16s. 1d.; last year, £17,232 17s. 10d.; increase, £903 18s. 3d. Mileage worked 46.

Glasgow Corporation Tramways.—Receipts for week ending January 25th, £10,639; corresponding week last year, £8,460; aggregate to date, £413,610 19s. 11d.; corresponding period last year £320,097 17s. 4d.

Liverpool Overhead Railway.—The receipts for the week ending February 2nd were £1,272; corresponding week last year, £1,404; decrease, £132. Total to date, £6,867; corresponding period last year, £7,398; decrease, £531. Miles open, 6 miles 67 chains; last year, 2 miles 40 chains.

STOCKS AND SHARES.

Wednesday Evening.

The speculative fever in the South African Market remains the prime factor in Stock Exchange dealings, and many instances are noticeable of investors selling their higher-class shares in order to provide funds for gambling in Kaffirs. The Electricity Supply department is not wholly free from this influence, but its prices are remarkably well maintained, probably because of the large number of buying orders which follow each other persistently day by day. There is further strength to record in the telegraph section, which is still being hunted over by capitalists on the look-out for a bargain. In the railway market the principal move is a firming up in Central London issues.

Dividend announcements on Electricity Supply shares are late in making their appearance this year. The St. James's and Pall Mall, however, has already got its accounts out, and the meeting is convened for Tuesday next, February 11th. The net earnings amount to £36,632 for the year, which allows of the Ordinary shares getting 14½ per cent. for 1901. There is no change in the price of the shares. The main interest of the week is fixed upon Metropolitans, the Ordinary having jumped £1. Good buying, induced by dividend prospects, is responsible for this. On Bromptons it is expected that a larger distribution will be made than the 6 per cent. declared this time last year, and the Ordinary have risen ¼, while on Kensingtons we look for about the same as before. Considerable speculation upon the City of London dividend will be set at rest by the declaration of between 4½ and 5½ per cent. Those who are hoping for the middle figure may not be disappointed. The Westminster dividend at the rate of 11 per cent. per annum has produced no alteration in price, but Edmundson's are inclined to harden upon optimistic estimates as to the results for the last half of 1901. County of London Debenture stock has risen a point, and there is almost a Debenture famine in the market. Smithfield Market Ordinary have declined to 2, at which they are practically unsaleable.

In the Traction Market British Electrics command a brisk business, but there is no quotable alteration. The special settlement of the "Morgan" shares is taking place, and despite the assurance that was given as to none of the shares coming to market, there is a mysterious tap turned on somewhere, for which it is difficult to account. Calcutta Trams are somewhat in demand at 13½, and the strength of Anglo-Argentine Trams (the Chili scare being at an end) is well held, the shares standing at 4¼. London General Omnibus has climbed up from par to nearly 120 in the last six weeks. Speculative investors should investigate the position of the Bordeaux Tramways Company, the 250-franc shares looking cheap at £7¼ or thereabouts. Good results are being secured by this French concern, and there is a small market in our Stock Exchange. Blackpool and Fleetwood Tramroad shares are 13, *cum* the 9 per cent. dividend. The report states that the company carried over 1¼ million passengers in the latter half of last year.

Central London Ordinary and Preference are both a little better, and City stock—now *ex* 1½ dividend—is widened upward in quotation. The shares are lost in stock. The latest echo of Central London competition comes in the North London Railway dividend, which is reduced to 6½ per cent., the lowest ever declared by this company in a second half-year. The scheme for making a "Tube" from Cannon Street to Wandsworth and Wimbledon has been officially abandoned. Among the promoters who were interested in this ambitious attempt—eight millions was the estimated capital required—was the ubiquitous Mr. Ernest Schenk, the Crystal Palace chairman, who quite recently bought the electrified part of Isle of Man tramways.

The telegraph market, as hinted above, keeps buoyantly good. Anglo-American Preferred has gained another 1 per cent., the report being considered less unfavourable than had been expected. The fall of £9,600 in the half-year's takings is partly offset by a reduction of £6,900 in expenses. Those who have a profit on their Anglo "B" might fairly take it. The Ordinary and Deferred stocks are also better. Direct United States shares show a fresh improvement. Eastern Ordinary has spurted 2 (making 10 per cent. in a fortnight), and Chinas are ¼ up. The senior securities of the two Eastern companies are hardening, with the exception of Eastern 4 per cent. Debentures. Western Telegraphs continue their advance, and there has been quite a sharp revival in West India and Panama descriptions. Even the Ordinary are nearly 15s. once more.

National Telephone First and Second Preference have attracted attention, with a corresponding rise of £1 in each, but the 3½ per cent. Debenture is weaker. Both this and the 4 per cent. Debenture are not as scarce as they have been until this week.

In the more miscellaneous list, Globe Telegraph shares of each kind quickly recovered the dividends deducted last week, and no change is made in the quotation. Submarine Cables Trust certificates are wanted from America, and are somewhat harder. Henley's Ordinary have spurted 10s., and are that amount ahead of Callender's, whose Debenture stock, however, is a point harder. India-Rubber shares at 21½ are substantially harder, it being hoped that the company will, after all, benefit from the projected Yankee cable in the Pacific.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation Jan. 29th.	Closing Quotations Feb. 5th.	Business done during week ended Feb. 5th. 1902. Highest.	Lowest.
82,300	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3½— 4½	3½— 4½	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	70 — 80	70 — 80	...	...
804,720	Anglo-American Telegraph	Stock	73/6	3½%	61s.	50 — 52	51 — 53	52	50⅜
3,097,640	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	94½— 95½	95½— 96½	96	94½
3,097,640	Do. do. Deferred	Stock	£1 7s.	5s.%	2s.	8 — 8½	8¼— 8¾	8⅜	8¼
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	...	3¾— 4	3¾— 4	...	...
13,333,300$	Commercial Cable	$100	8 %	...	...	165 —170	165 —170	...	...
1,741,029£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	90 — 95	93 — 96	94¾	94¼
16,000	Cuba Telegraph	10	7 %	...	...	5 — 6	5 — 6	...	...
6,000	Do. 10 % Pref.	10	...	...	...	13 — 14	13 — 14	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	8½— 9½	8½— 9½	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	98 —102	98 —102	...	...
60,710£	Direct United States Cable	20	3½%	3½%	...	9¾— 10¼	10 — 10½	10½	10⅛
101,300£	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	132 —137	134 —139	139	136
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	89 — 91	90 — 92	92	91¼
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	109 —113	109 —113	110½	...
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	...	13½— 13⅝	13½— 14	13⅞	13⅝
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	109 —114	109 —114	...	..
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5¼%	...	...	100 —103	100 —103	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103 %	100 —103	...	...
180,227	Globe Telegraph and Trust	10	5¼%	5¼%	...	9½— 10	9½— 10 xd	10	
180,042	Do. do. 6 % Pref.	10	...	...	...	13½— 14	13½— 14 xd	13 9/16	...
150,000	Great Northern Telegraph, of Copenhagen	10	...	15 %	...	28 — 29	28 — 30	...	...
75,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —103	99 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	...	38 — 42	38 — 42	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	102 —105	102 —105	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	2½%	...	...	¼— ½	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	...	...	¾— 1	¾— 1	...	...
590,000	National Telephone, 1 to 590,000	5	5 %	5 %	...	3⅜— 3⅞	3⅜— 3⅞	3 13/16	3 11/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	11 — 13	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	11 — 13	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	...	4¾— 5	4¾— 5	...	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	...	94 — 97	93 — 96	94½	...
500,000£	Do. 4 % Deb. Stock Red.	100	...	4 %	...	101 —105	101 —105	102½	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	...	⅞—1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's...	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,303	Submarine Cables Trust	Cert.	...	...	...	117 —123	118 —124	...	...
58,000	United River Plate Telephone	5	7 %	...	...	4¾— 5½	4¾— 5½	5 3/16	...
40,006	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4½— 5	4½— 5	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	102 —105	102 —105	...	...
155,600	West African Telegraph, 5 % Debs....	100	...	...	...	100 —103	100 —103	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ⅜	⅛— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	12¾— 13¼	13 — 13½	13⅜	12⅞
75,000£	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	102 —105	102 —105	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	101 —104	100 —103	...	...
88,321	West India and Panama Telegraph	10	5%	...	...	½— ⅝	⅝— ¾	⅝	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5 — 6	5½— 6	5½	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3 — 4	3½— 4½	4	...
80,000£	Do do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	100 —103	100 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord. ...	1	...	...	...	⅜— ⅝	⅜— ⅝	...	...
100,000	Do. 4½ % 1st Deb. Stock, Prov. Certs.	100	...	...	...	97 —102	97 —102	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	...	9 — 9½	9¼— 9⅜	9½	9 5/16
20,000	Do. do. 7 % Cum. Pref....	5	...	...	...	9 — 9½	9 — 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	...	8 — 9	8 — 9	...	...
50,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5 — 5½	5 — 5½	5⅜	...
250,000	Do. do. do. 4% Deb. Stock Red.	100	...	...	...	103 —105	103 —105	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	5½%	...	5½— 6	5½— 6	...	...
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	108 —111	108 —111	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	4 %	0 %	...	9 — 10	9 — 10	9½	9⅜
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12 — 13	12 — 13	12 9/16	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	121 —126	121 —126	...	...
200,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	101 —104	101 —104	101¼	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	...	8½— 9½	8½— 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12 — 13	12 — 13	...	...
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	105 —108	106 —109	108¼	107
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	...	5½— 6	5¾— 6¼	6	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5½— 6	5¾— 6¼	...	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	105 —108	105 —108	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11 — 12	11 — 12	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	103 —106	101 —104 xd	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 1⅝	1½— 1⅝	..	...
49,840	Do. do. do. do. 6 % Pref.	5	...	...	...	4 — 5	4 — 5	4⅝	...
250,000£	Do. do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	95 —100	95 —100	...	..
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	...	14½— 15½	1 ½— 16½	15 15/16	15⅝
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	111 —115	111 —115	113¼	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 99	96 — 99	...	...
8,652	Notting Hill Electric Lighting	10	7 %	7 %	...	15 — 16	15 — 16	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15½— 16½	15½— 16½	15¾	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	...	8½— 9½	8½— 9½	...	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	97 —100	97 —100	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90 xd	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
109,518	Westminster Electric Supply, Ord.	5	13 %	10½%	...	12 — 13	12 — 13	12⅝	12⅜

* Subject to Founders Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.
¿Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation Jan. 29th.	Closing Quotation Feb. 5th.	Business done week ended Feb 5th, 1902. Highest	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	‡ 10	...	...	...	4⅛ — 5⅛	4⅛ — 5⅛	4 15/16	4⅞
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	87 — 91	87 — 91	90	...
62,074	British Electric Traction	10	8 %	9 %	...	14 — 15	14 — 15	14⅛	14 5/16
90,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12½ — 13	12½ — 13	12⅞	12 9/16
600,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	128	128
70,000	British Insulated Wire Ord.	5	20 %	15 %	...	10½ — 11⅛	9½ — 10½	10 1/16	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5⅝ — 6¼xd	5⅝ — 6¼	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	...	⅞ — 1	⅞ — 1	1⅛	...
50,000	¶ „ „ „ 6 % Cum. Pref.	£1	...	6 %	...	1 1/16 — 1 1/16	1 1/16 — 1 1/16	...	...
105,731	Brush Elecl. Enging., Ord., 1 to 105,731	2	5½ %	5 %	...	1⅜ — 1⅝	1⅜ — 1⅝	1 7/16	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	...	2 — 2¼	2 — 2¼	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	102 —105	102 —105	105½	104½
125,000*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	97 —100	99 —102	99½	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	...	16½ — 17½	16½ — 17½	...	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6	...	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	110 —114	111 —115	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	4 %	105 —108	106 —109	108¼	107
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	4 %	105 —108	106 —109	...	...
440,100	Do. do. Def. do.	Stock	...	...	4 %	106 —109	106 —109	...	...
855,000	City and South London Railway	Stock	1½%	1½%	2 %	65 — 67	65 — 68	67	66
47,500	Do. do. Ord. shares Nos. 22,501 to 70,000	10	...	...	...	6½ — 6⅝	6 — 6½	...	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	7½%	8 %	...	3 — 3½	3 — 3½	3⅜	3 3/16
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —104	99 —104	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½%	...	⅛ — ⅜	⅛ — ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½%	...	2 — 3	2 — 3	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	78 — 83	78 — 83	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	84 — 89	83 — 88	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1⅜ — 2¼	1⅜ — 2¼xd	...	...
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2½ — 3	2½ — 3	2⅞	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	97 —101	97 —101	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	9⅜ —10¼	9⅜ — 10¼	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	99 —102	99 — 102	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	...	16½ — 17½	17 — 18	17¾	17½
35,000	Do. do. do. 4½ % Pref.	5	4½%	4½%	...	5½ — 6	5½ — 6	...	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	112 —116	112 —116	...	...
50,000	India-Rabber, Gutta-Percha and Telegraph Works ...	10	10 %	...	...	20 — 21	21 — 22	21⅛	...
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100 —103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¾%	3½%	...	5⅛ — 5⅜	5⅛ — 5⅜	...	...
10,000	† Do. do. Pref., £10 paid	10	5	...	...	11¼ — 11⅜	11¼ — 11⅜	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500	10	...	...	...	15½ — 16½	15½—16½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	6 %	...	... — ...	19/- to 20/-	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	...	35 — 38	35 — 38	37½	...
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...%	...	...	102 —104	102 —104	...	...
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	5	12 %	12 %	...	10⅝ — 11⅛	10½ — 11⅛	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½ — 6	5½ — 6	5 13/16	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	91 — 94	91 — 94	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance 2/—4/-
National Electric Free Wiring, 17/6 paid, ⅜—¾.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16.
Do. do. Pref. (£10 pd.), 10⅜—10¾.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 4 per cent. (October 31st, 1901).

MARKET QUOTATIONS, Wednesday, February 5th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	29/-	29/-	..
a „ Oxalic	per cwt.	32/-	32/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a „ „ ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£20 10	£19 5	25s. inc.
a Lead, Nitrate	per ton	£24	£24	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C),	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	9d.	9d.	..
a „ Caustic (76/80%) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	125/-	125/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	£6 5	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a „ Crystals	per ton	£8	£8	..
a „ Bichromate, casks ..	per lb.	2½d.	2½d.	..
METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b „ Wire, in ton lots	per ton	£224	£224	..
b „ Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £125	£75 to £125	..
c Brass (rolled metal 2" to 12") basis	per lb.	6½d.	6½d.	..
c Tube (brazed)	per lb.	7½d.	7½d.	..
c „ „ (solid drawn) ..	per lb.	6½d.	6½d.	..
c „ Wire, basis	per lb.	6½d.	6½d.	..
c Copper Tubes (brazed) ..	per lb.	8½d.	8½d.	..
c „ „ (solid drawn) ..	per lb.	8½d.	8½d.	..
g Copper Bars (best selected) ..	per ton	£71	£66	£5 inc.

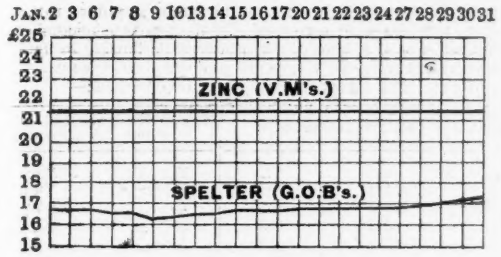
METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£71	£66	£5 inc.
g „ Rod	per ton	£71	£66	£5 inc.
e „ Electrolytic) Bars ..	per ton	£63	£55	£8 inc.
e „ „ Sheets ..	per ton	£75	£70	£5 inc.
e „ „ Rod ..	per ton	£68	£63	£5 inc.
e „ „ H.C. Wire	per lb.	8½d.	8d.	½d. inc.
f Ebonite Rod	per lb.	9/-	9/-	..
f „ Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine ..	per lb.	3/3	3/3	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants) ..	per ton	44/9	44/3	6d. inc.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i „ Wire, galvanised No. 8 ..	per ton	£9 10	£9 10	..
g Lead, English Ingot	per ton	£11 15 to £12	£10 17 6 to £11	inc.
g „ „ Sheet	per ton	£13 10	..	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 15	£8 15	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large ..	per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	11½d. to 1/2	11½d. to 1/2	..
p „ rolled bars & rods	per lb.	1/- to 1/3	1/- to 1/3	..
p „ „ strip & sheet	per lb.	From 1/2	From 1/2	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10d. to 1/-	10d. to 1/-	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i „ „ in bars		£58	£58	..
g Tin, block	per ton	£112 10 to £113 10	£109 10 to £110 10	£3 inc.
g „ foil	per lb.	1/6	1/6	..
n „ wire, Nos. 1 to 16	per lb.	1/5	1/5	..
p White Anti-friction Metals — "White Ant" brand	per ton	£35 to £65	£35 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j „ 6 lea. Flax	per lb.	5½d.	5½d.	..
j „ 8 ply 10 lbs. Russian ..	per lb.	4 1/2d.	4 1/2d.	..
j „ 10 lbs. Russian, single ..	per lb.	4½d.	4½d.	..
j „ 150 lbs. Jute rove	per ton	£10 2 6	£10 2 6	..
k Zinc, Sh't. (Vieille Montagne bnd.)	per ton	£22	£21 10	10s. inc.

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd e Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

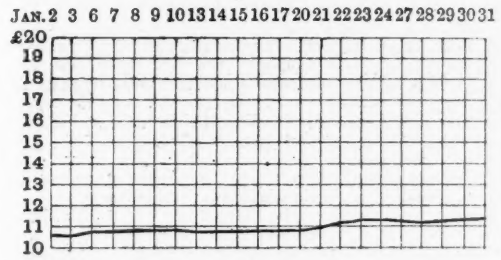
Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare, [Co., Ltd. h Messrs. Edward Till & Co. i Messrs. Bolling & Lowe. j Messrs. Walter H. Hindley & Co.

Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd p The Phosphor Bronze Company, Ltd.

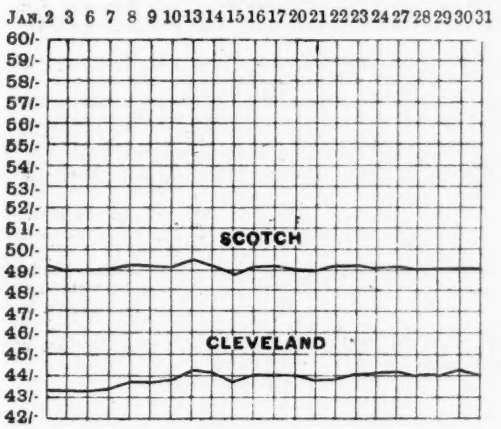
METAL MARKET.—Fluctuations in January.



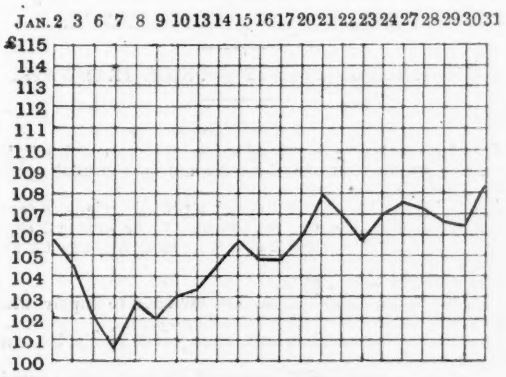
LEAD (ENGLISH).



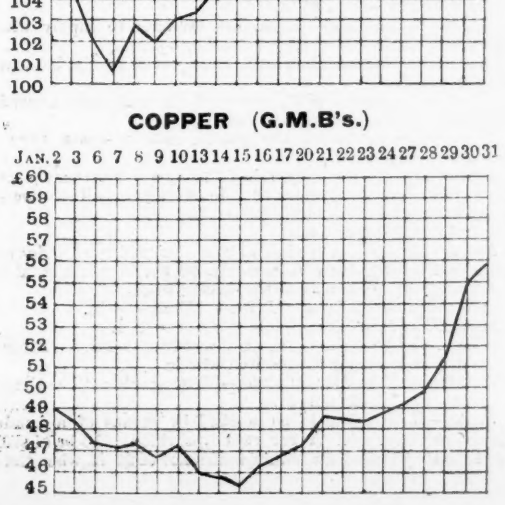
IRON.



TIN.



COPPER (G.M.B's.)



INSTITUTION OF ELECTRICAL ENGINEERS.

EARTH CURRENTS DERIVED FROM DISTRIBUTING SYSTEMS.

By E. Basil Wedmore, Associate Member.

(Abstract of Paper read January 23rd, 1902.)

Particular interest has recently been aroused in connection with the subject of earth currents, principally owing to the consideration which has been given to the question of the protection of observatories and other places from magnetic disturbances, due to the use of the earth as a return conductor in traction work. Although some of the questions raised have been of only temporary interest, yet as it is certain that wherever there are electrical distribution systems there will certainly be earth currents, the consideration of the earth as a conductor and of the phenomena accompanying earth currents is a subject of permanent interest.

I am indebted to Mr. Trotter, with whom I was experimenting in March, 1900, for drawing my attention to certain early work of Heaviside's, which forms the basis of the following considerations.

The principal conclusions with reference to the magnetic effects were arrived at before April, 1900, but I was prevented at the time from publishing them, except among interested parties.

On first consideration it might appear that the magnetic effects at any point away from the rails would be produced principally by the currents in the immediate neighbourhood, but this is not the case, for the magnetic forces due to the long distant streams of current are roughly only inversely proportional to their distance. In determining the magnetic effects at any point it is necessary, therefore, to consider the magnetic effect due to the current system as a whole.

Should the whole current return by the rails the magnetic effects due to the current in the trolley wires and rails would practically cancel, except in the immediate neighbourhood. A large proportion of the current, however, returns by the earth, and at a distance from the trolley wire. The magnetic effects due to the current in the trolley wire, therefore, are not cancelled by the return currents. In this sense it is correct to say that the effects are due to the earth currents.

There is, perhaps, something more than an analogy between the electric and the magnetic flux. The two fluxes are always linked together in closed circuits, and there is a definite quantitative relation between the two.

We are familiar with the calculation of magneto-motive force in a closed magnetic circuit, from the current flux passing through that circuit, from the relation:—

$$4\pi \times \text{current flux} = \text{magneto-motive force}$$
$$\text{or line integral of magnetic force.}$$

In general, in any magnetic system produced by a corresponding current system, we may calculate the current passing through any closed curve by taking the line integral of magnetic force round that curve and dividing by 4π.

The first practical deduction to be made from these considerations is, that at any point where the magnetic flux is relatively weak, the current must also be relatively weak.

On the assumption that the conductivity of the earth is uniform, and that the return currents enter and leave at points, it may be shown that the magnetic force directly due to the earth currents has no vertical component. If this is so, then no part of the vertical component due to the current in the trolley wires and feeders is cancelled by the earth currents. We may see, also, that, except close to the line, the magnetic field due to the current in the trolley wire will have no horizontal component. In the hypothetical case, therefore, the horizontal component is wholly due to the earth currents and the vertical component to that portion of the trolley and feeder currents that is not cancelled by the rail return current.

Should the assumptions made not be representative of the real conditions, then, in the real case, some portion of the vertical component will be cancelled, and the magnetic field reduced. The only exception to this would occur in case there were a large conducting system lying in and parallel with the current stream, and having good electrical connection with the earth.

As the above allocation of the horizontal and vertical components of the magnetic forces is of considerable importance, some amount of explanation is desirable. Take the simplest hypothetical case in which a certain current goes from A to B in an insulated conductor lying on the earth's surface, and returns by the earth, entering the earth at the point B, and leaving it at the point A. The magnetic field due to the current in the insulated conductor will be a circular one, the lines of force entering and leaving the earth's surface at right angles, so that at the surface there is no horizontal component.

Consider now the current flux entering the earth at the point B. The current will tend to spread out uniformly in all directions, its density decreasing with the square of the distance and the potential varying inversely as the distance.

Now the magnetic field due to a current entering the earth's surface at B and diverging uniformly will obviously be symmetrical about a vertical axis. It will have equal strength at equal radii at points on the earth's surface and in planes parallel to it. Assume for the moment that the current arrives at B along a straight vertical wire, then any closed curve on the earth's surface including the point B will include the whole current. We have now found two conditions, namely:—

(*a*) Uniform, and therefore circular, distribution of the magnetic field, the circles having circumferences of $2\pi r$.

(*b*) Line integrals round these circles to be all equal and to have valve $4\pi c$.

The field strength, therefore, at any point, will equal $2c/r$. The field at the surface, however, due to the long wire bringing up the current to the point B will $= c/r$, therefore the field around B, due

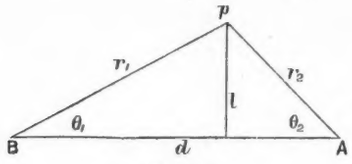


FIG. 1.

to the diverging current flux, which is what we require, will also equal c/r. It is obvious from symmetry that there can be no vertical component.

We may now resolve our forces due to the systems at A and B. For the horizontal component, if B is distant d from A, then the force at any point p distant r_1 and r_2 respectively from B and A $= c\,d/r_1\,r_2$ in absolute units.

If the current is fed along a wire from A to B, the vertical component at $p = \frac{c}{l}(\cos\theta_1 + \cos\theta_2)$ where l = perpendicular distance of p from the wire and θ_1 and θ_2 are the angles between the wire and r_1 and r_2 respectively. It has already been shown that current passing along the trolley line and feeders and returning by the rails has no appreciable magnetic effect except in the immediate neighbourhood of the track. For the purposes of calculation, therefore, we neglect this portion of the current. For the purpose of a first approximation we may guess at two points, A and B, at which the current may be supposed to enter and leave the earth, and apply the above formulæ.

Mr. E. Parry has shown that on the assumption that the principal resistance offered to a current entering or leaving the track is in the immediate neighbourhood of the track, that the track is uniformly grounded, and that all the current enters the rail at one end and leaves it at the other, the amount of current leaving the track from point to point follows an equation of the same form as Fourier's equation for the heat flux radiating from a long conductor heated at one end. Prof. Rucker arrived independently at this result, and has shown how to calculate the vertical magnetic effects on the assumption of the Fourier bar theory and source and sink theory combined, and Dr. Glazebrook has worked out some examples and deductions from the same.

Fortunately I find an intelligent use of the simple formulæ given above leads to quite as accurate results as the use of the more complex formulæ alluded to.

Doubt has been thrown on the truth of the fundamental assumption of the source and sink theory. It has been suggested that while the experience of traction engineers goes to show that the earth is a very reliable quantity, yet the earth may not be a homogeneous conductor.

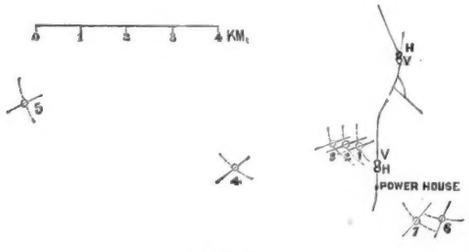


FIG. 2.

Now a little consideration will show that the formulæ deduced above for the magnetic effects at the surface of the earth, due to return currents flowing through it as a homogeneous conductor, are equally applicable to the surface conditions due to certain currents in a thin layer of earth.

As this is a point of considerable importance, I shall proceed to show that the theory fits the facts.

Prof. Rucker has already shown an agreement between theory and experiment based on measurements made at Stockton. I give below

	0·4 mile.		0·8 mile.	
	V.	H.	V.	H.
Observed	4·5	3·0	1·5	1·5
Calculated	4·2	2·1	1·7	1·25

V = Vertical component. H = Horizontal component.

the measured disturbances reduced to 100 amperes in the out-going feeder, the line being two miles long and the observing stations 0·4 and 0·8 mile distant, along a perpendicular from the centre of the line, and with them I give my calculated values on a first approximation. The unit used $= \frac{1}{100000}$ absolute units.

Dr. Edler's experiments covered a much larger area, the most distant observing station being nearly five miles from the track.

Fig. 2 shows the relative position of the track and of the seven stations at which observations were made. From the observed forces I have calculated the leakage currents. I have assumed that a current flowing through the earth between the points, H H, would produce about the same horizontal disturbance as the actual current stream, and that a current of uniform strength flowing in the trolley wire between the points, V V, would produce about the same vertical disturbance. The following are the results obtained:—

Station.	Observed disturbance.		Leakage current calculated from observed disturbance.	
No.	V.	H.	From H	From V.
1	25·2	9·5	53 amps.	64 amps.
2	10·6	6·1	47 „	57½ „
3	4·3	4·3	46½ „	42 „
4	0·95	1·3	77 „	66 „
5	0·24	0·44	113 „	59½ „
6	1·00	1·4	58½ „	37 „
7	1·10	1·7	52 „	36½ „

Although at first sight this may not seem a striking confirmation, an examination of the figures in the two right-hand columns, together with the diagram, reveals several interesting features.

1. Except at the first two stations, the vertical force appears to have been proportionately less than the horizontal, showing that some portion of the vertical force has been cancelled by irregularities in the current streams. (The line bends outwards towards the first two stations, which being the nearest, are most affected thereby, thus accounting for the apparent discrepancy.)

2. The current fed along the part of the line below the power house is reversed in direction, thus accounting for the apparent reduction of the vertical effects at Stations 6 and 7, without affecting the horizontal disturbance.

3. Considering the above, the vertical effects are more uniform than the horizontal, which would be expected from the uniformity of distribution of the line current as compared with the earth currents.

4. It may be noted that, excepting Station 5, at any particular station, there is a good agreement between the currents calculated from the two disturbances. The differences between station and station are undoubtedly due to variations in the load from day to day, the experiments having been made on different days at different stations. At Station 5 the whole calculation turns on the measurement of a few millionths of a line of force per square centimetre.

Taking the figures as a whole we may estimate the leakage current as about 60 amperes—not an unlikely value considering the length of the line, and the service, 15 motor and two trailer cars.

The direction of the observed horizontal disturbances is indicated in fig. 2. In the case of a current sheet these disturbances should be normal to the current stream lines. These lines should be circles passing through the points H, H. The dotted lines in the figure are portions of such circles, and it will be seen that they are approximately normal to the magnetic lines.

(To be concluded.)

CURRENT SPECIFICATIONS.

XC.—LONDON COUNTY COUNCIL TRAMWAYS.

SUMMARY.

Extent of Contract.—Supply of either *fifty* or *one hundred* completely equipped electric tramcars for use on the Tooting section of the Council's tramways.

Type of Car.—To be of tenderer's standard designs, so far as he deems desirable. The car is, however, to be double-deck, with reversed staircase, and capable of seating in all between 64 and 70 persons.

Gauge of Line.—4 ft. 8½ in.

Limiting Dimensions.—Given, but tenderer to supply with his tender full particulars of those actually proposed.

Sand Boxes.—Of the Ham or other approved type to be supplied, two for each car.

Life Guards.—A sum of £15 per car to be reserved for expenditure on this item at the discretion of the engineer.

Roof Seats.—To be of the garden lath-and-space type with reversible swing backs.

Type of Truck.—Each car to be fitted with two maximum traction trucks, but every tender must contain at least two alternative prices for other standard types of bogie trucks.

Wheel Base.—To be 4 ft.

Arrangement.—Each truck is to be so designed that, under normal conditions, not less than 75 per cent. of the weight carried by the truck comes upon the axle of the driving wheel.

Mean Diameter of Tread of Driving Wheels.—30 in.

Mean Diameter of Tread of Pony Wheels.—20 in.

Wheels.—To be steel tired, with cast-iron centres. Alternative offers may be made for chilled iron wheels.

Diameter of Main Parts of Axles.—Driving axle not less than 4 in., pony axle not less than 3¾ in.

Brake.—Hand brake to be worked by means of a handwheel placed at either end of car to be provided. To be of sufficient power to stop loaded car within a distance of 50 ft. when the car is

travelling at the rate of 12 miles per hour. An electric brake is also to be provided, mentioned below, and when used in conjunction with the hand brake it is to be capable of stopping a loaded car travelling at the rate of 12 miles per hour within its own length.

Motors.—Two to be provided per car, capable when working together to accelerate a loaded car at the rate of at least 1 ft. per second per second on the level, and to maintain a steady speed of 12 miles per hour on any gradient up to 1 in 80, and eight miles per hour on a gradient of 1 in 22.

Current.—The voltage of the current is 500 to 550 volts, and it will be conveyed to the motors by means of conductors placed in an underground conduit, and collected by means of a plough to be supplied with the car, and made in accordance with the drawing supplied with the specification.

Design of Motors.—To be in accordance with latest modern practice, armature coils being wound in separate sections, so that they are easily removable.

Insulation Test.—Armature and field magnet windings to withstand a pressure of 2,000 volts alternating for a period of 30 minutes.

Tests.—Exhaustive tests of each motor are to be made in the presence of the representative of the Council before delivery.

Temperature Rise.—At the end of one hour's full load test temperature rise of any accessible part of winding not to exceed 135° F. above surrounding atmosphere.

Controller.—Two to be provided per car of the rheostatic brake type, complete with all suitable resistances.

Other Accessories.—An automatic minimum cut-out, a main switch, and a watt-hour meter to be provided on each car, also provision for connecting an ammeter in circuit if required.

Car Lighting.—Twenty-two lamps to be fitted per car, of which 20 will be in use at once, in positions named in the specification.

Illuminated Destination Boxes.—To be provided as specified.

Extras.—A sum of £40 per car to be allowed for disbursement at the discretion of the engineer.

Board of Trade.—All Board of Trade requirements are to be strictly complied with.

Specified Dates of Delivery.—Tenderer for either section of 50 cars to give dates at which he can undertake to deliver the cars quoted for. Attention is called to the fact that it is expected the car sheds will be ready for the cars in October, 1902, but tenderer must be willing, if necessary, to store the cars until wanted, free of cost to the Council.

Penalty for Late Delivery.—£5 per car per week.

Specified Terms of Payment.—80 per cent. on delivery of cars into the Council's car-sheds, 10 per cent. on taking over, 10 per cent. at end of 12 months.

Period of Maintenance.—Twelve months from date of taking over of work.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages to be Paid to Workmen.—See comments below.

Arbitration Proposals.—Not thoroughly satisfactory. See comments below.

Date for Receipt of Tenders.—March 4th, 1902.

The issue of this specification has been looked forward to for some time with interest by car, truck and equipment manufacturers. It bears the name of Prof. A. B. W. Kennedy, the Council's consulting electrical engineer, and it has evidently been prepared with the care that its importance demands. The present requirements are *one hundred cars*, but as these are only for the first instalment of the lines to be electrified, there is no doubt that the competition will be very keen.

We think that the latitude given to tenderers in permitting them within certain limits to quote their own standard manufacture is, under the circumstances, wise, and that it will result in the offers being appreciably lower than would otherwise have been the case.

The cars are specified to seat between 64 and 70 passengers, and in general are to conform to the drawing issued with the specification. The popular "reversed" type of staircase has been adopted, and a device not usually to be found in tramcars has been introduced. Halfway along the inside of the car each seat is to be divided by a partition framed and panelled in oak or other approved wood, and glazed above the level of the back of the seat. These partitions are not to extend across the car further than the edge of the seats, and are presumably for the purpose of minimising the draught, so often a source of annoyance to travellers in public conveyances.

The sum of £15 per car is to be reserved in the tender for the provision of an approved form of lifeguard, the details of which will be settled by the engineer after the contract has been awarded.

A pair of maximum traction trucks are to be provided for each car, but, in addition, every tender is to contain alternative prices for at least two standard types of bogie trucks. Steel tired wheels are to be included in the tender, but the credit may be named which will be allowed if chilled iron wheels are finally adopted. Since the cars are to be used in connection with a conduit system of electric traction, a plough carrier of a design shown on a drawing issued with the specification is to be constructed and attached either to the truck framing, or in some other manner proposed by tenderers. Any system suggested must allow free play for a distance of about 12 in. on either side of the centre of the car. From this carrier the plough or current collector will be suspended.

Detailed particulars are to be given in the tender as to the quality and chemical composition of the metal used in the construction of both car frame and truck, as well as a large number of technical details.

The motors, when working together, are to be able to accelerate a loaded car at the rate of at least one foot per second per second on the level, and to maintain a steady speed of 12 miles per hour on any gradient up to 1 in 80, and 8 miles per hour on a gradient of 1 in 22. The gear ratio is not to exceed 5 to 1, and the teeth must not be less than 4½ in. in width.

The controllers are to be of the rheostatic brake type, complete with all necessary resistances, and the usual switch and fuse accessories must also be provided.

As the cars are for use in connection with a conduit system, trolley poles and lightning arresters are, of course, superfluous.

Tenderers must remember that the sum of £40 per car is to be reserved in the tender for expenditure at the discretion of the engineer.

In our issue of September 6th last, we commented at length upon the general conditions attached to the specification for the generating plant for these tramways. Since the present ones are practically identical, there is no need to repeat our criticisms.

Mr. Fitzmaurice, the new chief engineer to the County Council, is substituted for Sir Alexander Binnie as the arbitrator in cases of dispute, thus carrying out the principle adopted by the Council of making *their own representative* judge in cases in which his own employer is one of the parties affected. We still consider this course of procedure wrong, and as a matter of principle, and not in any way reflecting upon the deservedly high reputation of the gentlemen who have from time to time acted as chief engineer to the Council, we trust that protests will be made by firms making offers for the work.

The labour conditions should make it possible for the work to be wholly carried out in this country. We are glad to note that this was so in the case of the plant contracts, and although we may complain of their stringency, and may consider that these clauses have been drawn up far more in the supposed interests of workmen than of the industry generally, yet if all competitors tender under the same conditions there is an element of fairness present which minimises the evil done by the working of the stipulations. It is when placed in competition with foreigners, who can, if they like, ignore these conditions, since in many cases they are inapplicable to them, that the British manufacturer specially feels the hardship of the heavy handicap he is under in the industrial race for orders. We are still of opinion that the Council has gone beyond its true functions as a purchaser in attempting to impose so many conditions as to the manner in which the work should be done, and we look forward to continued watchfulness on the part of the manufacturing industry in drawing attention to unjustifiable proposals on the part of the Council, resulting in the final adoption of a set of general conditions fair and acceptable to all parties concerned.

ENGLISH, AMERICAN, AND CONTINENTAL STEAM ENGINEERING.

In continuation of this series in the *Engineering Magazine*, Mr. Dawson deals at length with the Paris Exhibition of 1900, and deplores the fact of so few British engines being seen there. The principal reason of this was that the political animosity of France at the time was running so high against us, that people did not care to risk the loss. Now that the mantle of hostility has fallen on Germany, we see the same inclination to limit intercourse with that country. We rather doubt Mr. Dawson's conclusion that foreigners went away from the Exhibition believing Great Britain had yielded up her supremacy, because the facts at the time were only too well known.

The points of Continental engines are briefly enumerated. Our own observations in Paris tended to impress us with the complication of valve gears and the excellent surface finish in dull black of much of the work, a point that is certainly worth attention. There was an engine there which had a novel type of poppet valve, a seatless piston valve, in fact, which shut off steam by dropping past the port openings. It is noted that most alternating or polyphase machines had fixed armatures and revolving fields, which often served as fly-wheels, and many of the polyphase machines seemed heavy when compared with American machines of equal output, which might easily, however, be a good thing; in some German machines lightness was pushed to such extremes that in one case tie rods were put in afterwards. Most continuous machines had slotted armatures. Exciters were generally driven off the main shaft, though the author thinks it would be better to have them separate.

The rated capacity of the Continental machines is generally that at which the machine would work for several hours. This, says Mr. Dawson, differs from what has been found advisable for traction purposes where sudden overloads are frequent. He says that the better way is to build both engine and dynamo to be capable of carrying for two hours continuously from 25 to 50 per cent. overloads, and from 50 to 100 per cent. momentarily. It appears that in these respects Continental practice follows the American. We do not know that this practice is not in a sense sounder than the English practice of building a traction dynamo big enough to run a full-load test of eight hours, followed by an overload of 25 per cent. for two hours without serious heating.

American traction generators will not carry this test if rigidly enforced, and we think it should be known to all who have to do with the purchase of machinery, that English generators are fully

equal to such tests. At the same time, we believe such tests are wrong, and that by really meeting them English makers are practically selling as 100-kw. machines very much more powerful and durable machines than are sold for 100-kw. American or Continental rating. Indeed, one continuous current machine at Paris had a card on it which made a boast that the machine could stand 20 per cent. overload for a short time! We cannot agree that the specifications of competent engineers in Great Britain have been correct when they asked for two hours' overloads of 25 to 50 per cent. without injurious heating. Under such specifications American machinery has competed unfairly, and many machines have been accepted through stress of circumstances that could only by a stretch of courtesy be said to have been safely cool. The facts are that machines never do carry these 25 per cent. overloads in practice except for brief periods, and that their mean loads are so very low, that the much talked-of overheating does not occur. We know of more than one traction engineer who is with us in condemning the present system of specifying tests.

As examples of French steam engine work are cited the engines of the Paris Metropolitan Railway with cylinders 41·34 and 70·87 × 59·05 in. with a crankshaft 19·29 in. diameter in its bearings, which are 39·37 in. long. There are three bearings, the central one being between the fly-wheel and the generator. These are placed between the two cylinders, and the whole of the fly-wheel stresses must thus pass through the central bearing; not a very mechanical design for an engine of 2,500 h.p. The same design is followed by Dujardin, of Lille, in the engines of the Orleans extension railway at Thury, about three miles from the Quai D'Orsay terminus. The system is triphase.

Continental engines have a good deal of external finish. English work seems to stand a happy medium between this and the American slovenliness. Engines are usually of the tandem type, and even for traction work, triple expansion is employed as a rule, though one can hardly see where designers expect to secure any economy, unless it is that accumulators are so much used that an economical engine can be employed with advantage.

The usual German and Swiss type of vertical engine is the open front type with supporting steel columns. Bearings are self-adjusting or spherical, a system introduced, we believe, by Messrs. Hick-Hargreaves, of Bolton. The complication of the valve gear is noted, and the examination of the low pressure piston is most difficult in the steeple triple engines introduced in 1899, for it entails practically pulling down all the engine. Their great height is against them, and now for anything above 1,000 h.p. the A.E.G. put in horizontal engines with supported piston rods, back slides, and tail rods. Berlin has been practically placed in the hands of one company for all electrical purposes, hence the large stations and general good lay-out.

The article concludes with a description of the Italian Franco-Tosi engine of Legnano. This Italian Company appears to be obtaining considerable success.

HANDLING MOTORS IN REPAIR SHOPS.*

Electric railway repair shop practice has in America divided itself into two general methods of handling motors for repair purposes. One method is to take the truck out from under a car whenever repairs are to be made on a motor or wheels are to be renewed. The other is to leave the truck under the car and do all the work from the pit, lowering armatures and wheels into the pit. A great many master mechanics have decided opinions one way or the other as to which of these methods is best, but practice is so equally divided between them, and so many large roads are found on both sides, that one is forced to the conclusion that the difference in results between the two methods cannot be great. Indeed, some roads are using both, and such find that there is not much difference between them, provided the repair shop in either case is fitted with the right kind of apparatus for fully carrying out the plan of motor handling for which it is designed, and the motor equipments are also arranged accordingly. Summed up briefly, the arguments advanced in favour of each method are as follows:—When the trucks are taken from under a car the parts are in plainer sight and more accessible than if it is under the car. If the shop is as light as it should be, there will be little need for artificial light when working over a truck in the daytime, while if the truck is left under the car, artificial light must be used in any event. This itself is a disadvantage, not because of the cost of the light, but because men cannot work as fast or as well around a truck by artificial light as by daylight. It is also more agreeable for a repair man to work on a truck which is uncovered before him on the floor than with his head stuck up in a mass of dirty truck and motor mechanism, as he must if working from the pit, and better work can be expected of him. Truck-bolts are in an awkward position to get at for a man standing in a pit. On the other hand, those who favour doing all from the pit point to the time required to disconnect motor leads and hoist the car body when the truck is taken out from under. Taking the truck from under disturbs bolts and connections that would not otherwise have to be touched. More floor space is required when the trucks are run out from under. If the shops are as crowded as they are in some large cities, artificial light must be used in any event. Supposing that equally rapid devices are used for hoisting and lowering in both cases, the time taken to remove an armature by taking it down into the pit, or to remove wheels, would be shorter than by running the truck out from under the car, considered purely on the basis of the number of operations that must be undergone in both cases. But right here comes the question of how much the darkness and inconvenience of things in a pit will influence the time required, and that is a matter of guesswork. Probably it is sufficient to make little difference between the two methods. The equipment needed in the two cases is radically different. When all work is done from the pit, hydraulic or pneumatic jacks and sectional track for removing wheels must be provided. The pits must be extensive enough so that wheels and armatures can be carted away when removed and hoisted out at some other point. If trucks are to be run out from under, there must be provision for quickly hoisting the car body by quick-acting jacks, or, preferably, by a crane or tackle hung from the roof. The latter necessitates strong roof construction.

* *Street Railway Journal.*

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"Birmingham" writes:—"I am about to put down a lighting plant to supply about 25 shops rented by various tenants. I do not require to cross any public road, the whole being one block of buildings, and I want to know, Is there any Act or power which would stop me supplying the current through meters and charging a price?"

*** It is quite clear that any person may manufacture and dispose of electricity in any manner he chooses. He may fix his own price, and ascertain the quantity sold by the use of a meter, without any risk of interference. As frequently pointed out in the Electrical Review, the Electric Lighting Acts are permissive only; and while they confer benefits upon those who supply electricity under the protection of a provisional order, they place no restriction whatever on private enterprise. The above statement is absolutely correct in reference to our correspondent's letter, inasmuch as all his "consumers" are in one curtilage. No overhead wires (the use of which may complicate a case) will therefore be necessary.

EXHIBITION OF ILLUMINATION BY THE COOPER-HEWITT MERCURY VAPOUR LAMP.

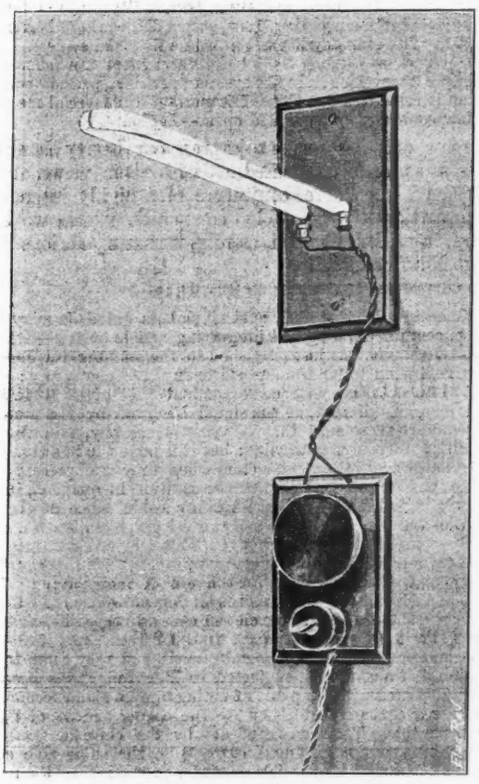
At the opening meeting for the year of the American Institute of Electrical Engineers, held in New York City on January 3rd, the subject for discussion was methods of illumination. The chief interest of the evening centred in Mr. Cooper-Hewitt's paper giving further descriptions of his experiments, and in his exhibition of his lamps in operation. Six lamps in all were on view, one of them being fixed vertically over the main entrance to the building, where its bright light, which could be seen from a great distance, proved an attraction and an object of curiosity to the passers-by. The remaining five were used to illuminate the lecture room, one being hung vertically from the centre of the roof, while the others projected horizontally at intervals round the gallery. These were continuously in operation during the meeting from 8 to 11 p.m., and by their light some excellent photographs of the interior were obtained. These have been reproduced in the *Electrical World* of New York for January 11th, and amongst them there is a very striking photograph (taken with an exposure of about 12 seconds) of the president, Mr. Steinmetz. Incidentally we may mention that this photo. discloses one thing which might appear strange to an English audience, for President Steinmitz *has a cigar in his mouth!* The tubes were actuated by the ordinary 118-volt direct-current system, with the starting devices arranged on the platform.

From Mr. Cooper-Hewitt's paper, the text of which is given in the same issue of the *Electrical World*, we learn that these lamps use currents varying from 1 to 6 amperes, while the power is approximately 0·5 watt per spherical candle-power. With better conditions for economy, as high an efficiency as 0·25 watt per spherical candle-power has been obtained. Lamps have been made of varying diameters and

lengths, giving from less than 10 to over 3,000 candles, and the author says that there is no reason why lamps may not be made of any size required, and of any desired candle-power per inch within wide limits, except that there is a tendency of the glass to soften when too high a candle-power per inch is produced.

The *Electrical World* for January 18th gives two more photos. of the lamp itself, with some further particulars of its efficiency, and a diagram of the starting device. From this we learn that the lamp over the doorway was of 700 C.P., and consumed 0·5 watt per candle with, and 0·4 watt without, the starting device in circuit.

Attention has already been drawn in our previous descriptions of this lamp to its peculiar colour—what our contemporary calls "its disagreeable bluish-green colour"—owing to the lack of red rays in the mercury vapour. This constitutes an objection to its use for ordinary illumination of interiors, but Mr. Cooper-Hewitt considers that for ordinary street lighting the mercury lamp is available even without the red rays, its light having an advantage over that of the ordinary incandescent lamp in being more penetrating and effective through greater distances; while for certain



Cooper-Hewitt Vapour Lamp.

kinds of work, involving a strain on the eyes—such, for example, as reading and drawing—he considers the absence of the red rays to be an advantage, as such light is less tiring to the eyes. He has, however, succeeded in making lamps in which the colour objection is overcome, involving thereby a sacrifice on some occasions of the extremely high light efficiency obtained by the type shown.

The greater part of Mr. Cooper-Hewitt's paper deals with his experiments upon the electrical properties of the gas, especially its conductivity, which is the most important factor in the operation of the lamp. As the results of some of these experiments have already been dealt with in our columns in discussing the patent specifications (see Electrical Review, May 24th and October 25th, 1901), we need not dwell upon them here; but one experiment may be referred to, as it clears away a doubt which had at first formed itself in our minds. In this experiment, an ordinary lamp about 30 in. in length contained a rod of metal $\frac{1}{4}$th of an inch in diameter, projecting from the negative mercury electrode up to $\frac{1}{4}$th of an inch from the positive electrode, and a movable bridging piece allowed this rod to be put in electrical connection with the positive electrode. When contact was made and current passed, and then the contact broken, the current passed from the positive electrode direct to the mercury instead of to the metal rod in its vicinity, although the total resistance over the lamps required 60 volts with about 2 amperes passing, while that of the rod was practically negligible.

From this experiment, it appears to us to be quite clear that the conduction in the lamp takes place in the gas, and not, as we at first were inclined to think from other incidents described, along the glass of the tubes. The phenomenon described is quite in keeping with the well-known behaviour of the electric discharge in low-pressure tubes. It has been often observed that while a current may easily be made to pass between electrodes in such a tube with comparatively low potentials if the electrodes are well apart from each other, the passage of the current demands an extraordinarily high potential when the two electrodes are brought very close together. In a recent paper* it has been shown that this is due to the fact that under such conditions there is a very high fall of potential between the electrode and the gas in contact with it, and that this drop of potential is greatly diminished when the electrodes are separated further apart. Thus in Mr. Cooper-Hewitt's experiment, the result is in accordance with the general behaviour of the electric discharge through a gas at low pressure, the resistance of the gas-path between the positive electrode and the negative mercury being less difficult to overcome than that of the short path to the metal rod.

In determining the resistance of the gas-path itself, the author finds that it varies directly with the length, and inversely with the diameter (not with the *square* of the diameter, as in metallic conductors). The voltage between the terminals is modified by the density of the gas, there being a particular value of the density for which the conductivity is a maximum. The author states that he has used other gases than mercury vapour, but that mercury has many advantages for general investigation. Much care and ingenuity has evidently been expended on this work by Mr. Cooper-Hewitt, and there is good reason to hope that he may soon meet with still further success. We note with pleasure the tribute of our contemporary, the *Electrical World*, to his work: "It is positively refreshing to have an experimenter in a new field deal with his work in a scientific spirit, instead of playing to the galleries."

AMERICA FOR AMERICANS.

We have been given permission to print the following extract from a letter written towards the end of last year by a well-known English engineer to his firm in this country:—

These words indicate exactly the position of affairs in America. There can be no mistaking this fact, and the moment one enters the States, it seems to be the predominating feature in every direction. In the most important, as well as the very cheapest, newspapers these sentiments prevail. No opportunity is missed to show up America, and (as the Commodore of New York Yacht Club said at Sir Thomas Lipton's reception and dinner after the yacht race) "America is predominant."

This is what every American believes, and on this principle they stick to each other through thick and thin, and being so full of enthusiasm, and thoroughly imbued with their own importance, it helps them immensely to carry on the every day affairs of life in a pleasant but plucky manner.

No opportunity is ever lost of displaying to the country what its people are capable of producing, either in agriculture, manufacture, or commerce.

I feel that I envy their loyalty, because in this old country of Great Britain we are so divided on these subjects, and it now seems that Great Britain is for anybody else but a

* See paper by Prof. Skinner, "Conditions Controlling Fall of Potential at the Electrodes in Vacuum-Tube Discharge," *Phil. Mag.*, December, 1901.

Briton. This is exemplified not only by the large quantity of manufactured goods imported, but by the sentiments of many of our best and leading daily papers. Many of these seem to think it is a virtue to decry their own country, and to applaud their American cousins, and what they are doing. It is true that many of the Americans are a sanguine, go-ahead people, but with the exception of their railways, tramways, and other specialities, most of which are particularly adapted to their own country and American ideas, I see but little that Britons cannot do equally well, and in most cases, at any rate as regards steam engine practice, better. If only we could infuse into the British race at home the same national spirit and love for their own country which is exhibited in America, it would be a good thing for Britons.

Some of our technical papers have tried to do justice to British productions, and for these manifestations of goodwill to British trade, one cannot but feel grateful, and my sincere wish is that the technical papers were more read by the public.

In some of our important daily papers, columns and columns of leading articles are written about the sentiments of Home Rulers, Unionists, and Imperial Liberals, together with no end of particulars on sport, whilst the real life and blood of the nation dwindles away by our fiscal system of free trade and the open door in our colonies. Little or nothing is said in the papers about these important matters. An excellent book on this subject has been written by Mr. J. Westley Gardner, called "The Ruin of Rural England."

Again, our British Government commercial policy seems not to have been framed upon a good system with the best and most up-to-date methods for obtaining good results. It is of the utmost importance to British traders that the consuls abroad should send home frequent returns of what is being done, what is in demand, and everything that relates to the commercial interest of this country. But in many cases the consuls are not men at all suited for their posts, they seem to have been appointed not because of their suitability, but because they are the friend of some nobleman, and quite irrespective of any qualifications they may have for the post. It has frequently happened when the writer has been abroad and wanted information that he has had to apply either to the German or American consuls, rather than to the British, as frequently he was either unable or unwilling to give it. In the writer's opinion the consuls should be men of indefatigable energy and perseverance, with a full knowledge of commerce and trade generally, possessing indomitable pluck and determination, and with a full knowledge of the language of the country which they represent as well as one or two other modern languages. In addition to this, they should be enthusiastic with a pleasant but strong British national feeling.

WIRELESS TELEGRAPHY v. SUBMARINE CABLES.

IV.

Sir James Pender did good public service last week in bringing before the notice of the shareholders of the Direct United States Cable Company the articles on "Wireless Telegraphy *v.* Submarine Cables" which we have been publishing during the last month.

In the electrical press of this country, at all events, those financially or scientifically interested in every branch of the electro-technical industry may be sure of honest, impartial, and critical opinions, based upon theoretical and practical experience, and wholly uninfluenced by what Mr. Whittaker Wright would term "press calls."

At the meeting of the Eastern Telegraph Company also, Sir J. Wolfe Barry, in an admirable speech, discussed at great length the *pros* and *cons* of wireless telegraph competition, and, in addition, laid before the stockholders the reports which Sir W. H. Preece and Dr. Oliver Lodge had been requested to prepare. The consensus of scientific opinion is all against the probability of the Marconi, Lodge, or any other system of wireless telegraphy competing with the submarine cable. Dr. Lodge, who, if he has not gone to such lengths as Marconi, from the practical point of view, is certainly equally well aware of what is possible, says: "To the best of my belief, submarine cables will for a long time be pre-eminent for the purpose of long-distance telegraphy. It is manifest that wireless or open methods cannot compete in point of secrecy and certainty with closed or cable methods, and could only compete with them in point of speed and accuracy by aid of great improvements and new inventions involving little less than discoveries."

Sir W. H. Preece is equally emphatic, and concludes that submarine cable enterprise has nothing to fear, in a commercial sense, from the competition of ætheric telegraphy.

The dozen or so opinions we have quoted in the course of our articles, with the exception of Mr. Guarini's, are all to the same effect, and we think enough has now been said to make stockholders in cable companies feel that whatever other causes may influence them to the extent of unburdening themselves of their holdings, the fear of wireless telegraph competition should not be reckoned as one of them.

The following paragraphs from the *Daily Mail* of the 3rd inst. are not without their significance :—

New York, Sunday, *February 2nd.*

Advices from Honolulu, dated January 21st, telegraphed here from San Francisco, report that the Inter-Island Telegraph Company, which has been operating Signor Marconi's system of wireless telegraphy since May, 1900, suspended work on November 25th, 1901. The company has not proved a financial success.

In such work as setting the clocks throughout the islands by chronometer from Honolulu the system proved a perfect success. But when it came to a question of important commercial messages the system could not be depended upon.—*Laffan.*

It is now only left for us to express our hearty thanks to those who so readily favoured us with their views, and to put forward one more conjecture of a highly interesting nature, particularly to cable companies, which we have received from Mr. Guarini, as to how that mysterious "S" reached Newfoundland.

Our correspondent writes as follows :—

The *Cosmos*, of Paris, which, in the numbers dated January 11th and 18th, contained a long and interesting article on trans-Atlantic wireless telegraphy, has just published in the number for January 25th the following letter from an officer in the French army :—"In No. 886 of the *Cosmos*, your correspondent 'N' gives 10 feasible explanations, all different, of the signal observed by Mr. Marconi. I beg to add to these an 11th. Wireless telegraphy, according to its definition, dispenses with wire: but it is none the less true that the Hertzian waves follow conductors when they are presented to them (*e.g.*, the antenna). Why, on the occasion in question, should they not have followed the trans-Atlantic cable, since at the two extremities the wireless station and the telegraph station are adjacent. It seems to me that this hypothesis suggests another; the English trans-Atlantic cable company would, in such a case, fail to see the joke, and would charge for the use of their property." It must be owned that the hypothesis is an ingenious one. In fact, in September, 1900, I and M. Poncelet signalled to the Académie des Sciences, Paris (*Comptes Rendus*, 2nd half-year, pp. 540—541, No. 13), an experiment on the metal screens, and they came to the conclusion that a conductor subjected to Hertzian waves becomes, in its turn, a transmitter capable of acting upon a given receiver.

Thus the hypothesis mentioned by the correspondent of *Cosmos* becomes feasible. The waves sent out by the Marconi station at Lizard Point produced induced currents in the submarine cables ending at Newfoundland, which currents, producing in their turn waves going into space either through the water or along the cables to the receiving stations, produced a very appreciable effect on the very sensitive Marconi receiving apparatus at St. John's, Newfoundland. This hypothesis is all the more probable from the fact that the Marconi receiving antenna, which it is known was supported by a kite, was—according to the illustrations published—bent over the sea.

In other words, it was a case of an action similar to those exercised by disturbances of atmospheric electricity, especially lightning, on telegraph circuits. It is true that this action is minimised in the case of underground wires and submarine cables; it is minimised, but it is there all the same. Moreover, the action would become very appreciable if the cables were continued by lines passing into the air through the earth. It would be interesting to obtain the opinions of the cable companies concerned, and to know whether, at the time Marconi was transmitting signals from Lizard Point, any disturbances were observed in the receiving apparatus of the two stations, especially the Newfoundland station. Even if this were not the case, it would not prove that the hypothesis of the *Cosmos* correspondent was erroneous, as the waves might have followed the iron sheathing of the cables, in which case the effect on the receiving apparatus would be negligible, and almost nil. It is true, moreover, that the sheathing of the cable is in communication with the sea water and with the bottom of the sea, which, according to the above-mentioned note by myself and Poncelet, would render the effect of the new radiator (the sheathing of the cable) almost nil, but it must not be forgotten that the sheathing of the cable is perhaps not in perfect contact with the water and with the bottom of the sea, owing to the deposits upon it. And has it not been shown that a

telephonic transmission has been sent through a naked copper wire laid on the ice? There is a loss at the earth, but the effect of better conductivity (than the medium in which it is immersed) still exists. If the hypothesis of the *Cosmos* correspondent is correct, the Marconi transmitter at Lizard Point imitated lightning on a small scale. Lightning is very powerful, but on the other hand, its waves are propagated in all directions, whereas the Marconi transmitter, while less powerful, concentrates its waves by means of the antennæ. It must, moreover, be concluded that the syntonisation brought forward by Mr. Marconi is not sufficient, that the waves must not be allowed to be propagated in all directions (even on the cables), but must be concentrated exclusively on the receiver. Lastly, the fact that both lightning and the wireless telegraphy transmitters can exercise a certain influence upon wires submerged at the bottom of the sea (sometimes at a depth of several kilometres) enables one to believe that in wireless telegraphy at sea the waves are propagated through the water, as I myself think. (See Electrical Review, May 24th, 1901.)

ELECTRICITY SUPPLY IN BULK.

We print below a copy of a letter which has been received by the London Chamber of Commerce from the Board of Trade. This letter is certainly a gratifying indication that the Board of Trade share the views of the E.T. Section, that while the existing high-pressure regulations of the Board of Trade are restrictive and inapplicable to extra high-pressure systems (*i.e.*, systems above the Board of Trade "high-pressure" limit of 3,000 volts), the time is not ripe for compiling hard-and-fast regulations for these. It appears that what is wanted is as much freedom of action as possible, to discover by trial and experience the methods best adapted to the industrial conditions obtaining in Great Britain. Further, the letter is a sensible recognition that the real problem to be solved is of an economic rather than a technical nature. The schemes offer great potential benefits to industry and the sanitary conditions of life. They should, therefore, have no unnecessary restrictions placed on them in such matters as pressure of supply, use of overhead wires, sizes or capacity of mains, thickness of dielectric, &c., which would tend to aggravate the difficulty of securing capital and earning a reasonable return upon it.

The Board of Trade being broadly prepared to consider each case on its merits, it is important that individual undertakers should not risk the creation of undesirable precedents by proposing to, or accepting from, the Board of Trade conditions which will prejudice subsequent undertakers. To provide against this, the Power Schemes Committee of the Electrical Trade Section will continue in existence as a medium for conference among electrical engineers and undertakers concerned with such schemes.

London Chamber of Commerce.

Sir,—With further reference to your letter of June 19th, 1901, enclosing a memorandum from the Sub-committee of the Electrical Section of the London Chamber of Commerce, on "Electrical Power Distribution Schemes," I am now authorised to inform you that the Board of Trade have not found it possible to settle any general form of regulations for extra high pressure.

Maximum Pressure.—The Board of Trade have never fixed any general limit of pressure. A limit of pressure is made in each case, as a necessary item of the description of the system. The Board of Trade are prepared to consider any description of methods of working when the undertakers specify in detail the precautions which they propose to adopt, and when they convince the Board of Trade that the use of high pressure is justified by the commercial conditions of the undertaking.

Maximum Power.—The Board of Trade have never fixed any general absolute limitation of the size of mains. They are advised that while the use of mains carrying very heavy currents may involve risk of danger to the public, the limitation of power in the case of extra high pressure mains may be considered chiefly with reference to the continuity of supply, the number of mains, their duplication, and the arrangement of the districts to be supplied.

Laying and Protecting of Cables.—The regulation which principally affects the mode of construction of mains is No. 33 as follows:—

Where any high pressure electric line is laid beneath the surface of the ground, efficient means shall be taken to render it impossible that the surface of the ground or any neighbouring electric line or conductor shall become charged by leakage from the high-pressure electric line.

No regulation could be more elastic than this. It is open for undertakers to propose any method which they consider suitable. One method which has been approved is the use of a metal sheath in addition to the lead covering; others have been approved.

Thickness of Dielectric in Cables.—No regulation making a particular thickness of dielectric, in the case of cables intended for extra high pressure, has been made by the Board of Trade. Reg. 9 is as follows:—

Every high-pressure conductor laid after the date of these regulations shall be continuously covered with insulating material to a thickness of not less than one-tenth part of an inch, and in cases where the extreme difference of potential in the circuit exceeds 2,000 volts, the thickness of insulating material shall not be less in inches or parts of an inch than the number obtained by dividing the number expressing the volts by 20,000.

"High pressure" is limited by definition to 3,000 volts.

Regulation 10, also applicable only to "high pressure," is as follows:—

A high-pressure circuit shall not be brought into use unless the insulation of every part thereof has withstood the continuous application, during one hour, of pressure exceeding the maximum pressure to which it is intended to be subjected in use, that is to say, in the case of every electric line a pressure twice the said maximum pressure, and in the case of every machine, device, or apparatus, a pressure of 50 per cent. greater than the said maximum pressure.

The undertakers shall duly record the results of each test.

Each case of extra high pressure must be considered on its merits, for the present.

Permission to Use Bare Overhead Wires.—The regulations for "aerial lines" do not apply to cases of extra high pressure.

The following letter was sent by the Board of Trade to the London Chamber of Commerce on February 23rd, 1892:—

Board of Trade (Railway Department).

Sir,—With reference to the letter addressed by the London Chamber of Commerce to the President of the Board of Trade, enclosing a copy of a memorial signed by a large number of electrical engineers and representatives of electrical firms in the United Kingdom, urging that this department should not lay down as a settled principle that no overhead conductors for the supply of electric energy should be allowed, but that, in rural districts at least, the circumstances of each particular case should determine whether overhead work should or should not be sanctioned, I am directed by the Board of Trade to say that the memorial in question appears to have been prepared under a misapprehension of the practice of this department.

The Board of Trade are of opinion that, as a general rule, the use of overhead wires is accompanied by many disadvantages, both as regards the safety of the public and the efficiency of the supply of energy, and they think it is most desirable that mains for the supply of energy under provisional orders or licences should, wherever practicable, be placed underground.

They have not, however, laid down any absolute rule that overhead wires shall in no case be employed, and while they have declined, in the absence of any special circumstances, to approve of a system in which the use of such wires was contemplated as a permanent arrangement in the central and populous portions of a town, they have on various occasions, where the circumstances appeared to justify it and the local authorities approved, authorised the employment of overhead wires in rural districts or the outlying or less populous portions of towns.

The Board of Trade see no reason to depart from the practice they have hitherto adopted of considering each application for permission to use overhead wires on its merits, having regard to the special circumstances of the district.

I am, &c.,

(Signed) Henry G. Calcraft.

The Board of Trade are prepared to consider the use of bare overhead wires when the undertakers specify in detail the precautions which they propose to adopt, and when they convince the Board of Trade that the use of such wires is justified by the commercial conditions of the undertaking.

Sub-Stations and Transformers on Consumers' Premises.—The Board of Trade are prepared to consider proposals for the supply of extra high pressure to sub-stations above ground.

Yours faithfully,

(Signed) Alex. P. Trotter.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1902.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London W.C., and at Liverpool, to whom all inquiries should be addressed.

1,475. "An improvement in feeder pillars for electric traction." C. Beckingsale. January 20th.

1,490. "An electric mechanism for operating electric time circuits and the like." H. Whidbourne. January 20th.

1,496. "Improvements in electric switches." H. H. Berry, P. F. W. Simon and E. Skinner. January 20th. (Complete.)

1,528. "An improvement in the manufacture of incandescent electric lamps." P. Scharf. January 20th.

1,534. "Improvements in electric light fittings." G. Markt. January 20th.

1,537. "Improvements in and connected with insulators for closed conduits." W. Griffiths and B. H. Bedell. January 20th.

1,546. "Improvements in electric cars operated by the overhead conductor system." H. McGILLIVRAY. January 20th.

1,565. "An improvement in parallel-series switches for dimming electric lamps." E. T. TURNER. January 21st.

1,575. "Improvements in or relating to electrical traction." B. BONNIKSEN. January 21st.

1,654. "Improvements in trolley pole connections and covers for tramcars and the like." J. W. BLAKEY and E. DEIGHTON. January 21st.

1,684. "A method for producing electrodes for electric accumulators." E. W. JUNGNER. (Date applied for under Patents, &c., Act, 1901, January 22nd, 1901, being date of application in Sweden.) January 21st. (Complete.)

1,688. "Improvements in the electrolytic separation, deposit and refining of zinc." H. PAWECK. January 21st.

1,735. "Improvements in electrical instruments." A. W. PRICE and CROMPTON & Co., LTD. January 22nd.

1,737. "Electric sweating robe." A. PHILLIPS. January 22nd. (Complete.)

1,744. "An improvement in motor-starting rheostats." A. TOWNSEND. January 22nd.

1,765. "An improved two-phase motor starting switch." A. SOAMES and W. LANGDON-DAVIES. January 22nd.

1,766. "Improvements in arc lamps." C. D. ABEL. (Siemens & Halske A. G., Germany.) January 22nd.

1,767. "Improved devices for varying the speed of continuous current electric motors." A. G. BLOXAM. (The firm of Couffinhal et ses Fils, France.) January 22nd.

1,768. "An improvement in electric bell pushes." C. H. BURT. January 22nd.

1,772. "Improvements relating to telephone systems." E. P. BAIRD. January 22nd.

1,780. "Improvements in transmitters (or receivers) for transmitting electrical waves through earth and water for steering torpedoes, signalling and the like purposes." C. G. G. BRAUNERHJELM. January 22nd.

1,808. "A new appliance or device for facilitating changing the trolley pulleys of overhead electric tramcars from one cable to another." J. BOYLAN. January 23rd.

1,820. "An improved method of laying cables." G. C. HURRELL. January 23rd.

1,851. "Improvements in the method of control of friction brakes, valves and the like by electro-magnets." J. G. CHILDS. January 23rd.

1,857. "Improvements in prepayment electricity meters." L. JOHNSON and R. HORNBY. January 23rd.

1,874. "Improvements in controllers for electric motors." T. S. PERKINS. January 23rd.

1,888. "Improvements in systems of electrical distribution." B. HOPKINSON. January 24th. (Complete.)

1,894. "Improvements in electric lighting arrangements for theatrical and similar scenic effects." W. J. PHILIPSON. January 24th.

1,902. "Improvements in telegraphic printing instruments." J. WHITCOMBE. January 24th.

1,910. "Improvements in electricity meters." K. ANDERSON. January 24th.

1,925. "A high-tension electric current commutator." J. A. CUNDY. January 24th.

1,961. "Improved method of heating metals in electric baths." J. GIRLOT. January 24th.

1,967. "Improvements in the manufacture of electric cables for telegraphic and telephonic purposes." H. W. DOVER. January 24th.

1,984. "An improved electric transformer." W. T. STUTCHBURY and C. GORICK. January 24th. (Complete.)

2,018. "Improvements in junction boxes for electric wiring." J. WALDRON and E. WHITE. January 25th.

2,019. "An improved coupling socket for electric wiring." J. WALDRON and E. WHITE. January 25th.

2,024. "Improvements in or appertaining to electrically-propelled tramcars and other vehicles." A. HILL. January 25th.

2,025. "Improvements relating to overhead tramway wires." J. T. PEARSON. January 25th.

2,034. "Improvements in electric arc lamps." H. BAGGET. January 25th.

2,035. "Improvements in electric arc lamps." H. BAGGET. January 25th.

2,058. "Improvements in rail bonds or connecting strips for the rails of electric railways." G. B. BLANCHARD. January 25th.

2,065. "Improvements in or relating to driving gear for electrically-propelled vehicles." W. L. WISE. (The Maschinenfabrik Oerlikon, Switzerland.) January 25th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1900.

9,061. "Improvements in or connected with electric brake for electrically propelled vehicles." F. C. Newell. Dated May 16th, 1900. When the motor on electrically-propelled cars runs as a generator to supply current to a local braking circuit, an electro-magnetic switch is included to shunt part of the current round the field coil of the motor if the current becomes excessive. The coils of this regulator surround fixed pole-pieces and movable cores which are connected by a crossbead carrying the flexible switch arm. When lifted into contact with the metal plates on the underside of the support for the crossbead, the shunt circuit which includes resistance coils is completed. The appliance is contained in a box furnished with a cover carrying these coils and binding posts as indicated. 3 claims.

9,084. "Improvements in arc lamps." A. G. Stockwell. Dated May 16th, 1900. Relates chiefly to brake wheels in arc lamps. 9 claims.

9,110. "Improvements in contact pieces for transmitting the current from the fixed base to the revolving or swinging top of electric search light projectors." M. Paul. Dated May 17th, 1900. The base of the lamp is fitted with two rings which rub on the contact plugs. The contacts are formed of copper wire gauze tightly rolled up. Each contact is fitted in a holder enclosed in a box and recessed to receive the cable. A spring is inserted to give a spring contact. 1 claim.

9,133. "An improved process for manufacturing homogeneous plates, more particularly applicable for use in electrical condensers." L. Lombardi. Dated May 17th, 1900. (Date applied for under Section 103 of Patents, &c., Act, October 31st, 1899.) Thin plates or laminæ, such as are used in electric condensers, are obtained by pouring the fused material upon a liquid mass of lower melting point and allowing it to cool. The film can then be lifted off. For making paraffin wax plates mercury is a suitable base. 1 claim.

9,203. "Improvements in dynamos." C. A. Parsons and G. G. Stoney. Dated May 18th, 1900. Consists in automatically adjusting the position of the brushes on the commutator of a continuous current dynamo, so as to maintain them in the position of minimum sparking at all loads, by means of a piston or diaphragm acted upon directly or indirectly by the steam pressure of the driving engine or turbine at a point where this pressure varies proportionally to the load. In connection with dynamos driven by steam turbines, governed in the usual manner, the use of the invention also prevents hunting. 3 claims.

9,212. "Improvements in or in conjunction with trolley or like current collectors for electric railways and tramways." J. H. Kinlip. Dated May 18th, 1900. Relates to electric railways and tramways with overhead conductors. Relates to a trolley rope holding and pulling down apparatus. To pull down the trolley pole in case the trolley gets off the line, the pole cord is attached to a spring barrel, which is normally locked by pawls. These are released by the jerk or by an electro-magnet excited by the completion of a battery circuit when the pole flies up. A rubber stop on the cord prevents the cord from being wound in too much. 5 claims.

9,229. "Method of and means or apparatus for testing alternating current generators, transformers, meters and analogous apparatus." Willans & Robinson, Limited, and G. L. Addenbrooke. Dated May 18th, 1900. Testing. Polyphase or single alternating current appliances, such as generators, transformers, and meters are tested on loads consisting of non-inductive resistances and variable inductances connected in parallel, in order that the conditions may be made similar to those on inductive circuits. A variable inductance for such testing may consist of wire or strip coiled through rectangular or other laminated iron frames, fixed radially about a non-magnetic centre; the outer sides or the ends of the frames are movable independently, by slit holders and screws, to produce adjustable air-gaps in the magnetic circuits. Or a central rotatable right and left hand screw may carry two nuts linked to the outer sides of the frames, to adjust these radially, simultaneously. A single rectangular iron frame with one side adjustable may be used. The grouping of the coils may also be varied. 3 claims.

9,233. "Improvements in bayonet joint attachments for glow lamps, safety fuses, wall contacts and similar devices." M. Weinberger. Dated May 18th, 1900. Capped incandescent lamps, differing in candle-power, are made with pins or slots of different sizes, numbers or positions, to fit corresponding bayonet-joint holders, in order that only one kind of lamp may be used in any particular holder. 2 claims.

9,260. "Improvements in or relating to electric light carbons." H. S. Browne. J. F. Sanders, Oregon.) Dated May 19th, 1900. Relates to arc and incandescent arc lamps. Electrodes are made of mixtures of carbon with metallic salts, which lower the temperature of the arc, produce more light, and colour the light. 16 claims.

9,263. "Improvements in electric heaters." A. R. Leask and P. M. Bellis. Dated May 19th, 1900. An electric heater, which may be placed in any ordinary vessel, consists of resistant wire wound across one or more rings or frames of insulating material, these being supported by nuts and distance pieces on two rods attached to a larger insulating piece which is intended to rest on the top of the vessel, and is provided with a knob. Electric connection between supply conductors and the heating wire is made by the rods and a spring switch which is closed by the weight of the heater when placed on the top of the vessel; the underside of the spring is coated with insulating material. 3 claims.

9,279. "Improvements in and connected with supports for electric conductors." P. A. Lorain and A. Donnery. Dated May 19th, 1900. Posts and other supports are made of rectangular metal tubes. The stays and other attachments are made of similar material, and are attached by clamping collars, plates, or socket fittings. The insulator supports are attached to the posts, &c., by clamping plates and collars, no holes being made through the posts, &c. The base ends of the stays are split and set in cement. When horizontal support tubes are employed, they may be attached to wooden uprights. 2 claims.

9,331. "An improved electrolysing apparatus." M. Haas. Dated May 21st, 1900. Relates to bleaching compounds, &c. 1 claim.

9,339. "Improvements relating to multiplex telephony." W. E. Evans. (E. A. Faller and J. W. Chisholm, U.S.A.) Dated May 21st, 1900. Relates to a system of multiplex telephony in which the receivers are arranged to have their electrical characteristics varied in pairs, so that the conversation between one pair shall not clash with that between another pair, although passing along the same main circuit. 6 claims.

9,397. "Improvements in and connected with armatures for dynamo-electric machines." G. Heidel. Dated May 22nd, 1900. An armature is built up of a number of independent core sections which are removably secured to collars on the shaft by means of screws passing through lugs. Displacement of the screws is prevented by rings. Each core section is wound with a separate coil, the ends of which are connected to two adjacent commutator sections. The commutator sections are provided with arms grooved on their upper surfaces to receive the connecting wires, and the latter are secured thereto by a cap and screw. When a coil becomes damaged, it may be cut out of circuit by means of a bridge wire at the commutator, or the section may be removed for repairs. A double armature with two commutators may be similarly constructed. 1 claim.

9,413. "Improvements in electric motor suspension on electrically propelled vehicles, such as tramcars and the like." G. Gibbs. Dated May 22nd, 1900. Relates to electric locomotives and motor vehicles. The motor frame or cradle consists of two side bars and two end bars. The latter are connected centrally by the hangers and upper and lower springs to lugs on the motor casing. The side bars are also connected by pivots being passed through extensions of or attachments to the shell. 5 claims.

9,458. "Improvements in space telegraphy." W. C. L. Eklin. Dated May 22nd, 1900. Relates to apparatus for determining the direction of the received waves in wireless telegraphy, applicable for signalling between ships. 8 claims.

9,464. "Improvements in the manufacture of filaments for incandescent electric light." S. B. Husselman. Dated May 22nd, 1900. Filaments for use in exhausted bulbs are made by repeatedly coating and drying a thread of asbestos or similar non-destructible material, with a coating material made by warming a mixture of two grains of aluminium shavings, three grains of iodine, and 1 lb. of pure alcohol to 108° F. in an airtight retort. After the last coating operation, the thread is formed by passage through rollers or a tube, and then heated to 3,500° F. or 4,000° F. in a closed mica retort, until the coating fuses to the core. 2 claims.

9,469. "Improvements in motor meters for alternating currents." A. Peloux. Dated May 25th, 1900. Energy meters for single alternating currents. In an induction motor meter, having a conducting disc or cylinder, driven by a shunt electro-magnet and main current coils displaced angularly on opposite sides of the disc or cylinder, and retarded by a permanent magnetic brake, in order to prevent the retardation due to eddy currents produced by the main current coils increasing when the main current is large, either the total magnetic flux through the disc or cylinder is kept constant, or an additional compensating driving force is provided. 5 claims.

9,492. "Improvements in ceiling roses and other like electrical connections." W. M. Douglas. Dated May 24th, 1900. A ceiling rose, or other similar electric connection for a two-wire supply. 3 claims.

9,511. "Improvements in the construction of swivel heads of electric car trolleys." I. F. Cuttler. Dated May 24th, 1900. Relates to electric railways and tramways with overhead conductors. A spring bolt bears against a cut-away portion of a flange on a swivelling fork which carries the trolley wheel to return it to its normal position in line with the pole. 1 claim.